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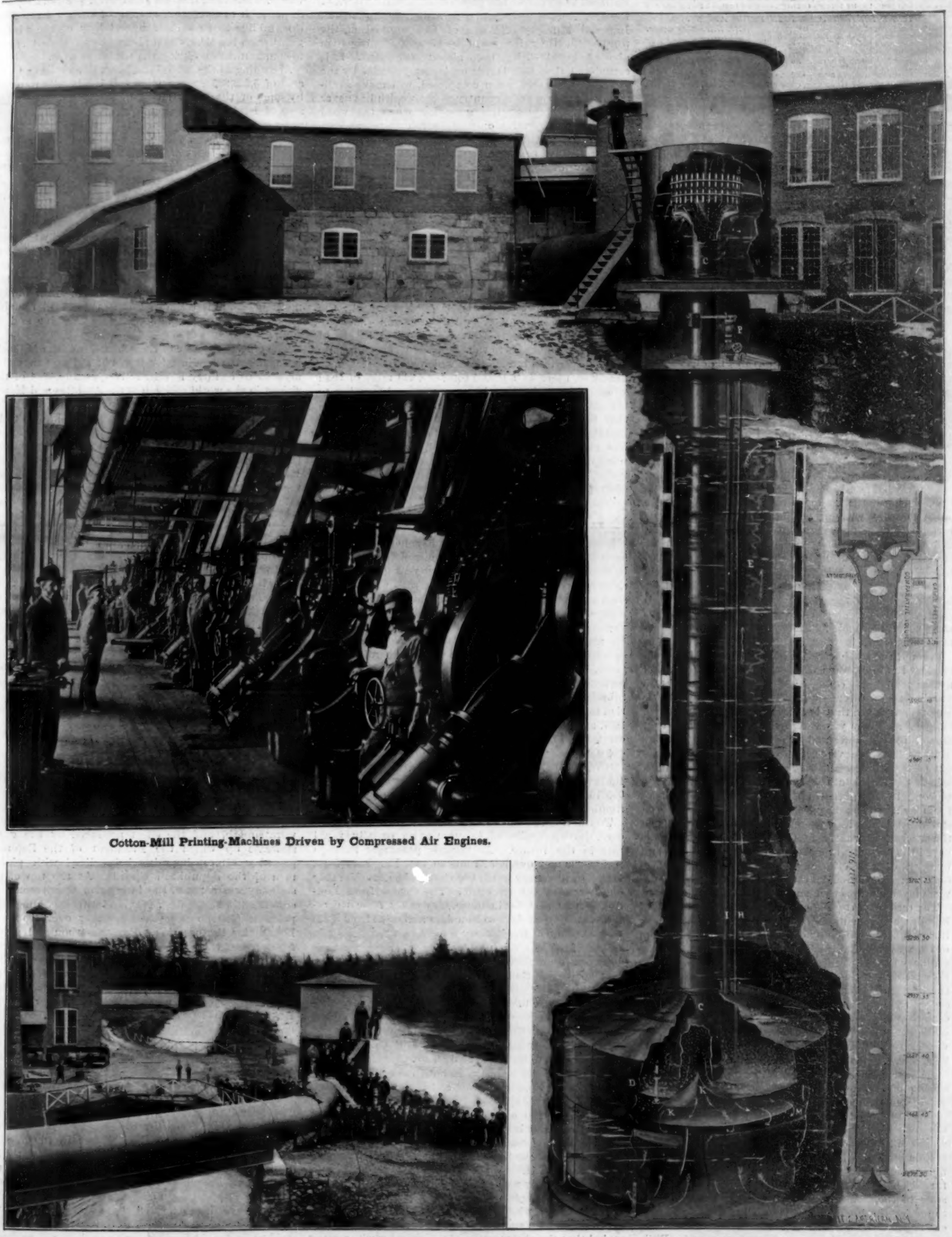

Cotton-Mill Printing-Machines Driven by Compressed Air Engines.

The Penstock and Receiving Tank.

Vertical Section, Showing Receiving Tank, Compressing Pipe and Separating Chamber.

THE HYDRAULIC SYSTEM OF AIR COMPRESSION.—[See page 263.]

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FINALITY IN INVENTION.

Invention is essentially continuous and progressive. It grows partly by development from within of the original idea, partly by the incorporation of various modifications and improvements from without. There is practically no such thing as finality in invention—no stage at which the inventor may fold his hands and say, with absolute certainty, "it is finished."

The recognition of this truth has been the foundation rock upon which the majority of the epoch-making inventions of history have been built up. Few, indeed, even of the common devices and implements of life have more than a faint resemblance to the form in which they were originally conceived and fashioned. More often than not the history of their development is a story in many chapters—a record of patient experiment, careful reasoning, countless trials, many failures, a few successes, and a triumph that came with double certainty because it came by slow degrees.

Invention as a science and art (for it involves both knowledge and practice) is better understood both as to its meaning and scope than it was. Thanks to the spread of education and the more practical spirit of the age, the popular ideas on the subject are changing for the better. The field of invention is ceasing to be regarded as a kind of idealized Klondike or Cape Nome, where the happy adventurer turns up the miner's nugget without the hardship and the heartbreak of the miner's life. This mistaken view was, and for that matter is yet, answerable for a number of half-finished but inherently valuable inventions, which, for want of a little persistence, have nothing to show but a pigeonholed patent and a machine that lies neglected in the cellar. In thousands of such cases, the inventor has thrown down his tools, if not at its very threshold, at least within measurable distance of success.

Proof of the truth of what we say is to be found in the fact that no sooner has some successful invention demonstrated its commercial value, than a certain number of inventors—and sometimes their name is legion—announce that the device is old, and that ten, twenty, aye fifty years ago they "invented" that identical thing, and should, therefore, be the recipients of its profits. We venture to say that, in nine cases out of ten, these claimants are sincere, and that, if asked to, they could produce the patent from the pigeonhole, and gather up the decaying fragments of the machine from the cellar. We also venture the statement that a like proportion of them differ from the successful inventor in this, that whereas they believed that they had reached finality, he did not; and by continuing his efforts upon the lines of experiment, invention and design, he carried their crude or incomplete investigations to a successful issue.

The records of the Patent Office contain thousands of half-finished inventions which are so far valuable that, if the owners would only develop them with a fraction of the zeal and intelligence with which they conduct the ordinary affairs of life, they would richly benefit both themselves and the general public. This is proved by the fact that there are not a few inventors who find it exceedingly profitable to take up the principles of discarded inventions, and by developing a practical embodiment of the same, give them that commercial value, which, by a little patience and industry might have been secured by the original inventor.

An instructive case in point is found in the hydraulic system of air compression which is illustrated elsewhere in this issue. It is possible that some of our readers will recognize in this plant a development of the ancient method of producing a furnace blast by means of falling water. The theory upon which this system is operated is by no means new, and some of the finest steel in the world has been made in the catalin furnace with the assistance of the water-blast. Yet, in spite of the fact that many attempts have been made to render the *trompe*, as it is called, amenable to modern requirements, and that a most careful scientific investigation was made some twenty years ago in Philadelphia of its theoretical possibilities, it is only within the last few years that the *trompe*, with its low efficiency, has been developed into the present highly efficient air compressor. We quote this as one among many similar illustrations of the fact that inventions with great inherent possibilities may lie dormant in a crude and impractical form for centuries, awaiting only the attention of a scientific and practical mind to make them permanently and adequately useful.

PROGRESS AND PROSPECTS OF THE TRANS-SIBERIAN RAILWAY.

In point of magnitude and cost the Trans-Siberian Railroad is certainly the greatest engineering work of the age. According to figures furnished by the Russian Imperial Ministry of Ways of Communication, the total cost of the railway will be $500,000,000, of which about $295,000,000 has been already expended. It is considered that this lavish outlay is justified by the fact that the work, when completed, will make available the resources of a country whose wealth has never been told. The day has gone by when the word Siberia was suggestive only of barren wastes and an outlawed population. Such opening up of the country as has already been accomplished, and the reliable testimony of various explorers, have dispelled this illusion and raised a reasonable expectation that Siberia will have a future comparable only to the development which followed the completion of the railroad system of the United States to the Pacific seaboard.

The two most important sections of the Trans-Siberian road are practically completed and ready for the cars. One of these extends from Cheliabinsk in the west of Siberia to a point which is only 120 miles from the northwestern frontier of Manchuria; the other section extends from Khabarovsk to Vladivostock. These two sections have a combined length of about 3,250 miles. If to this be added the aggregate length of various branch lines which are completed, or nearly so, there is a grand total of 4,300 miles of road which will soon be placed in operation. According to the official report above mentioned, it was determined that for the present the stations and various yard buildings, and in fact, the general construction of the line above sub-grade, should be built as cheaply as was consistent with safety and the strict necessities of traffic. Light rails were put down and wooden bridges of the Howe truss type, so well known in our Western railroads, were built, the intention being to replace them with more solid construction as soon as the increase of traffic would justify it.

It seems, however, that this policy has not been as successful in Siberia as it was on our pioneer railroads in this country, for during the last year large sums of money were spent in replacing the rails with heavier steel and erecting steel bridges in place of the wooden trusses referred to. It may be that this sudden reversal of policy is due to the remarkable increase in the traffic which has taken place thus early after the opening of the line, an increase which, according to reports, has been altogether beyond expectations. According to figures published in the official guide to the Siberian Railway, the total number of passengers carried in 1896 was 160,000, and this increased to 236,000 in 1897, and to 379,000 in 1898, while the amount of freight carried had increased in two years from 169,000 tons to 484,000 tons. This increase refers only to traffic upon the West Siberian Railway. Upon the Central Siberia Railway, the number of passengers increased from 177,000 in 1897, to 476,000 in 1898, while the amount of freight carried rose from 87,000 to 177,000.

To the Russian official mind there is no doubt, whatever, that the traffic will increase at an equally rapid rate in the future. As regards passenger through traffic, the new overland route to the Far East from Europe will occupy much less time and be considerably cheaper than the sea route. The voyage from London to Shanghai, for instance, now takes from thirty-four to thirty-six days to complete and costs from $350 to $500, whereas the journey by rail between these two cities, if made at the present rate of speed, which is between twenty-three and twenty-four miles an hour on the Siberian Railway, can be made in sixteen days, or less than half the time, at a cost of $175. It is not by any means upon through passenger traffic, however, that the Siberian Railway will depend for its revenue, for it is the enormous anticipated shipments of freight from which the promoters of this road expect to realize its profits. It is expected that the freight traffic will be heavy in both directions, for not only will the opening up of railway communications between China, Japan, and Corea and the European markets lead to a large importation of European goods, but there is a considerable export trade which only awaits the completion of the railway to enable it to escape from the heavy shipping rates which at present are obtained.

The net yearly receipts from the working of the road when it is completed are estimated at a little over $4,000,000, and while this looks to be a very small return on such an enormous outlay, it is to be borne in mind that the construction of this great work was not undertaken so much with a view to commercial profits as from a desire to develop a vast region which is rich in natural resources, and to secure the military and naval advantages which rail communication will confer. In connection with the construction of the railway, systematic explorations have been made of the various great river systems which it intersects, and which form its natural feeders. Hydrographic parties have been sent out which are surveying both the rivers and that great inland sea, Lake Baikal, whose shores are reputed to be rich in mineral wealth. The government is facing the serious problem of building a railroad around the southern shore of the lake, a work which, while both difficult and costly, is absolutely indispensable to the future success of such a trans-continental line as this. The uncertainty of the winter weather on the lake would always be a serious menace to communication during the winter months.

According to the official statistics, Siberia has a total area of 5,333,333 square miles. It is liberally watered by some of the finest rivers in the world. The total area of land that is capable of agricultural development is about 20,000 square miles, and the soil of these sections consists of a deep layer of black loam. A total of about 16,500 acres of land has already been colonized, and the government is now parceling out the prairies through which the line runs, with the confident expectation that Siberia will become one of the most powerful competitors in the world's supply of wheat. For the immediate future it is expected that the new settlers will devote themselves chiefly to cattle raising, which, so far, has proved to be profitable. It seems that the virgin forests of Siberia have been cut down in the same ruthless and wasteful manner that characterized the denudation of our own forest lands; nevertheless, it is estimated that there still remains about 80,000 square miles of valuable pine and fir timber.

The official estimate of the mineral wealth of Siberia is remarkable reading, for it would indicate that this mysterious country is, minerally speaking, one of the richest in the world. North of the Aral Sea and Mountains the land is rich in lead, silver, copper, and gold. Several ranges of the Altai Mountains are known to be rich in gold, copper ore, and minor precious stones, while the varieties of porphyry and jasper, known by the name of this range, have an established reputation. Extensive deposits of coal are found in the Kusnetz region. It seems that in far Eastern Siberia the mountain ranges are equally rich in silver, copper, iron, coal, and graphite, while the gold fields of Eastern Siberia are known to be particularly promising. Elsewhere, coal and naphtha have been developed, while the coast line of Eastern Siberia has yielded good results to the gold washers.

We have been so frequently told during the progress of the Trans-Siberian Railway that the work was being undertaken mainly for military and strategic reasons, that it is with peculiar satisfaction we learn from this official guide that the resources of the country are in themselves sufficient to warrant the construction of the railway. Just how far the opening up of such a vast and apparently rich region will effect the present economic equilibrium of the world, it is difficult to foretell, but that its influence will be far-reaching and profound, can scarcely be disputed.

OPENING OF THE PARIS EXPOSITION.

The Paris Exposition opened on April 14, with imposing ceremonies which were held in the Salle des Fêtes, and nothing could have exceeded the picturesque stage setting. The uniforms of the diplomats and soldiers were gorgeous, the orchestra and chorus were superb, and the effect produced by the great staircase up which the President of the Republic passed was most imposing, being lined with picked men of the Republican Guards. At the top of the stairway was a room, the interior of which could be seen from the Salle des Fêtes, and this was hung with priceless Gobelin tapestries brought over from the Louvre for the occasion. Fourteen thousand guests formed the audience. The traffic arrangements were inadequate and many of the guests did not succeed in getting down to the grounds. The ceremonies were simple and impressive. After the speeches had been made and the Exposition was declared open, President Lonbet and his party passed over the Champs de Mars and took a steamer up the river to the Alexandre III. Bridge. The President was saluted on his trip up the river at the various national pavilions. After the boats reached the Alexandre III. Bridge the party landed and admired the vista up the Esplanade of the Hôtel des Invalides and the new Avenue Nicholas II. The President then proceeded to the Champs Elysées where the party entered carriages and were escorted to the Palace of the Elysée. In the evening Paris was brilliantly illuminated. The next day the Exposition, or rather a portion of it, was opened to the public. On the whole the Exposition is in a state of great incompleteness, and probably will be until the end of May. It is expected that no motive power will be ready until that time. The United States exhibit is said to be the farthest along toward completeness of any, except as regards machinery, where Germany

leads. In general readiness Russia came next to the United States.

There are 30,000 French exhibitors; 6,564 United States exhibitors; 2,500 Belgian; Germany has 2,000; Italy, 2,000; Russia 1,500; Scandinavia 1,400; Austria, 1,000; Great Britain, 600. The United States exhibits occupy 329,052 square feet, in forty-seven distinct exhibition spaces, thirty-three in the main Exposition grounds, and fourteen in the Vincennes Annex.

NATIONAL ACADEMY OF SCIENCES.

BY MARCUS BENJAMIN, PH.D.

The spring meeting of the National Academy of Sciences was held at Columbian University in Washington on April 17–19.

The meeting of the Academy held in Washington has usually for its most important feature the business that is transacted before it. Much of this is naturally routine, and only a portion of it is given to the public. The reports from the committees in charge of the various trust funds are usually presented and the committees in charge of the award of the medals of the Academy announce their decisions.

Perhaps the most important feature of the meeting is the election of new members. The names of those who have achieved eminence in science are presented by their sponsors before the Academy, and sometime before the April meeting a full list of those proposed are sent to the members for their approval. From this list the names of the seven candidates securing the highest number of votes are selected, and from them not more than five new members can be chosen each year. Owing to the difficulty in arriving at a unanimous decision in regard to the claims of those presented for membership, there is always much anxiety as to who the fortunate persons are. This year, those who were selected included James E. Keeler, who, after serving as an assistant at the Lick Observatory, passed to the charge of the Allegheny Observatory, only to return to the Lick as its director, succeeding Edward S. Holden in that place two years ago; Henry F. Osborn, the Da Costa Professor of Biology in Columbia University, New York, whose brilliant investigations in vertebrate paleontology has marked him as the proper successor to fill the vacancies caused by the deaths of Cope and Marsh; Franz Boas, who is professor of anthropology in Columbia University and an assistant curator in the American Museum of Natural History, New York, and whose ethnological studies among the Indians of the Northwest have gained for him much reputation; and Samuel L. Penfield, professor of mineralogy in Sheffield Scientific School of Yale University, whose frequent contributions to science in the way of new minerals made him a desirable addition to the Academy.

An award of the Barnard medal was made to William Conrad Roentgen for his discovery of the X-rays. The Barnard medal is given but once in every five years, and then to the person who has made the most important contribution to physical science during that period. Its first presentation was to Lord Rayleigh and Prof. William Ramsay, for their joint discovery of argon.

Another very important piece of business was the offer of Dr. Agassiz to give the sum of $5,000 to the National Academy as the beginning of a building fund to be raised in order to erect a suitable home in Washington, for the use of the Washington Academy of Sciences and of local or affiliated societies, on condition that the land needed for such a building be either given by the government or obtained from other sources; and, furthermore, that the sum of at least $100,000 be raised for that purpose, the National Academy to have such privileges granted them as they might need in the way of use of the hall at the proper time for their meetings, and of suitable smaller rooms to be used for office purposes. Dr. Agassiz also offered to give $1,000 to serve as a beginning of a general fund, provided sufficient money was raised to make that fund $20,000 as a minimum amount. Committees were appointed to take charge of raising both of these funds and to solicit subscriptions for them.

The papers presented before the Academy were very few, and of them that which created the most interest was "The Cruise of the U. S. Fish Commission Steamer 'Albatross' in the South Seas," by Alexander Agassiz. That cruise was begun in the month of August, 1899, and continued until the end of March of this year. Doctor Agassiz, with the aid of charts, gave a graphic account of the voyage, and told of the dredging and deep soundings made by the scientists of the expedition. Dredging and soundings were made at a depth of 4,500 fathoms, which is 1,600 fathoms deeper than any previous record. He described the animal life found at those depths, and also discussed the formation of coral reefs, contending that each reef required special study in order to determine the causes of its formation. Mr. J. E. Duerden, who was introduced by Prof. William K. Brooks, of Johns Hopkins University, presented a paper on "West Indian Madreporarian Polyps," in which he discussed the methods by which those corals were formed. A brief paper on the "Secondary Enrichment of Sulphides in Ore Deposits," was read by Samuel F. Emmons of the U. S. Geological Survey. He described the oxidation of ore zones of the noted mines in this and foreign countries, giving an interesting account of the various researches he had made and of the conclusions he had reached concerning the formation of ore deposits.

Among anthropologists there is probably no one subject on which a more decided opinion is held than on the subject of the presence of human remains in the Trenton gravels. At the Detroit meeting of the American Association a few years ago, it seemed as if those who believed that human remains in that formation were impossible, were in the ascendant, but the persistent efforts of the opposing faction may yet result in changing that opinion. Prof. Frederic W. Putnam presented a paper entitled "A Human Bone from the Glacial Deposit at Trenton, N. J.," in which he briefly described the finding of a human femur by one of his assistants, and exhibited photographs of the bone itself and a photograph of the bone in situ. Prof. Putnam has always been a firm believer in the existence of the Trenton gravel man. Prof. Theodore Gill, of the Smithsonian Institution, read a paper on "The Zoogeographical Relationships of Africa," in which he showed the relationship of the animals which recent geographical exploration of Africa has brought to light, with those on other continents. The "Report of the Watson Trustees on the Award of the Watson Medal to David Gill," was presented by Simon Newcomb, in this he described the qualifications of Prof. Gill for the Watson medal, telling how, as a comgaratively young man, he had been called to the charge of the observatory at the Cape of Good Hope, where with indifferent equipment and small funds, he had been able to obtain results that had gained him a high rank among astronomers of the world. He referred to the fact that Prof. William L. Elkin, of Yale University, had been associated with him in some of his important work.

In addition to the foregoing the following papers were presented by gentlemen not members of the Academy: "The Anatomy of Nautilus Pompilius," by L. E. Griffin, who was introduced by Prof. William K. Brooks (this was read by title); "On the Use of Electric Motors, of the Shunt Type, for Solving Linear Differential Equations of any Order with Variable Coefficients," by Reginald A. Fessenden, who was introduced by Prof. Cleveland Abbe (this was also read by title); Mr. Fessenden also read a paper "On the Prediction of the Physical Properties of the Pure Metals;" and Rollin A. Harris, who was also introduced by Prof. Cleveland Abbe, read "A Partial Explanation of Some of the Principal Ocean Tides." Both of these papers were results of investigations now being carried on at the United States Weather Bureau in the first instance, and at the United States Coast and Geodetic Survey in the second instance.

The additional members of the council who are annually chosen were as follows: Dr. John S. Billings, Dr. Henry P. Bowditch, Prof. George J. Brush, Prof. Wolcott Gibbs, Mr. Arnold Hague and Prof. Simon Newcomb.

It was with considerable regret that the Academy received the announcement from Prof. Wolcott Gibbs that his advancing years compelled him to resign from the presidency of the Academy. Doctor Gibbs is one of the three surviving original members of the Academy, and the one who has fairly earned the title of the "Nestor of American Science." He was for a quarter of a century Rumford professor at the Lawrence Scientific School of Harvard University, and on his retirement, some ten years ago, he returned to his home in Newport, where he has since devoted himself to the prosecution of chemical investigations. All of the great honors that can be conferred upon an American scientist have been given to him, and his absence from the meetings in the years to come will be severely felt.

AN AMERICAN AUTOMOBILE RACE.

The first real race of modern motor carriages which has ever been held in the United States, was run on April 14, on the Merrick Road, Long Island's splendid thoroughfare. The contest was held under the auspices of the Automobile Club of America. It was a battle royal between five gasoline, three steam carriages, and one electric vehicle. The course was fifty miles, and the prize a cup, donated by M. Léon Blanchet, was won by A. L. Riker, with his electric carriage. The time was 2:03:30. S. T. Davis, Jr., with a steam carriage, came in second, the time being 2:18:27. He was followed by A. Fisher, with a gasoline carriage, the time being 2:30:01.

The other competitors was D. Wolfe Bishop, Jr., gasoline carriage, 2:37:52; A. C. Bostwick, gasoline carriage, 2:46:40; G. F. Chamberlain, gasoline carriage, 2:48:42; and C. J. Field, gasoline carriage, 3:15:30.

Two carriages failed to finish, one of them losing a tire. The various towns along the course, from Springfield to Babylon and return, have never been particularly partial to racing of any kind, but on this occasion the authorities not only did nothing to interfere with the race, but did excellent work in keeping the road clear.

The turn at Babylon was made around two barrels at cross roads, and was successfully accomplished by all, except one steam carriage, whose driver attempted to make the turn too quickly, resulting in the loss of a tire. The winning machine carried sixty-four cells of battery, arranged in three sections, only two of which were used.

There were many wheelmen along the course, and several motor tricycles and quadricycles went over the course, one of them covering it in one hour and fifty-eight minutes.

PARIS EXPOSITION NOTES.

A model of the Brooklyn Bridge, made by the Roebling Company, which was shipped on the steamer "Pauillac," has been given up as lost, and a new model is being made. It will be sure to create general interest in Paris when it is exhibited. Miniature trolley cars will be run on the tracks.

In the two boiler annexes there is hardly a single plant actually erected, says The Iron Age, and there is also a great absence of gas and oil engines, which were in evidence in large numbers in the same locality in 1899. The United States machinery section is not well located, a considerable portion of it being below the gallery, which cuts off a great deal of the light.

The market price of admission tickets to the Exposition has fallen, and they are now selling as low as 6 cents. This is caused by the fact that when bonds were issued a few years ago to pay the expense of erecting the buildings, 65,000,000 tickets went with the bonds, and it is now estimated that the attendance will fall far below that figure, so that there will be a large quantity of the tickets which cannot be used. The authorities are requiring anywhere from two to five tickets, depending upon the hours of admission. The appearance of the grounds is much worse than on the opening day, and some of the smaller buildings are only just commenced and many of the large buildings are still incomplete. The Russian Pavilion is a notable exception.

Eleven of the valuable models of American warships have been injured during their transportation from New York to Havre on the auxiliary cruiser "Prairie." The models were inclosed in glass cases which were packed in wooden boxes and stowed in the hold. During the voyage the rolling and pitching of the ship caused them to shift, with the result that the glass was broken and this in turn broke and scratched the models, cutting their rigging and otherwise injuring them. The model of the "Olympia" suffered the greatest damage. It was thought at first that it would be necessary to have workmen sent from the Washington Navy Yard to repair the miniature vessels, but the French government offered Assistant Naval Constructor Gillmore facilities for doing this work at the shipyard at Cherbourg, which proposition was accepted. It is probable that the repairs will be of a temporary character.

CELLULITH.

In the making of paper it is known that by beating the pulp for a long time, a transparent and elastic mixture is obtained, which hardens rapidly on drying, covers the fibers and imparts great strength to the paper. An amorphous colloidal cellulose hydrate, as supposed, is produced, being set free from the cells, and acting as an agglutinating substance. This is also the theory of the fabrication of vegetable parchment.

In parchmenting paper by means of sulphuric acid, the cellulose is transformed into amyloid, which yields, with an excess of water, a gelatinous precipitate, uniting the remaining fibers, and forming a translucent sheet. The cellulith is prepared by a process exclusively mechanical—the beating of the pulp for a much longer time than is necessary for the production merely of paper. According to the properties of the pulp and the velocity of the revolving cylinder, the duration of the operation varies from 40 to 150 hours, until all the contents of the vat are transformed into a homogenous mass having no trace of fibers. In the state of extreme division the material still contains a good deal of air, which may destroy its regularity. So it is submitted to a new beating for about two hours.

If the cellulith is to be colored, the colors, soluble or otherwise, are added before the beating. The hot cellulose liquor is received into a reservoir perforated at the bottom, from which it drips. With 96 per cent of water the consistence is that of thick honey. The water is evaporated either in the open air or in a stove at 40°. The pulp hardens gradually and finally reaches the consistence of horn. Its specific weight is then about 4·5. The cellulith may be worked like horn, ebonite and other similar substances, and is, as compared with celluloid, uninflammable. In mixing the cellulith, at the moment of trituration, with sawdust and 30 per cent of lamp black, a kind of very dark ebonite is obtained, dense and susceptible of a polish.

The new material, says La Revue de Produits Chemiques, is adapted to a variety of purposes for which horn and other similar substances have been hitherto used.

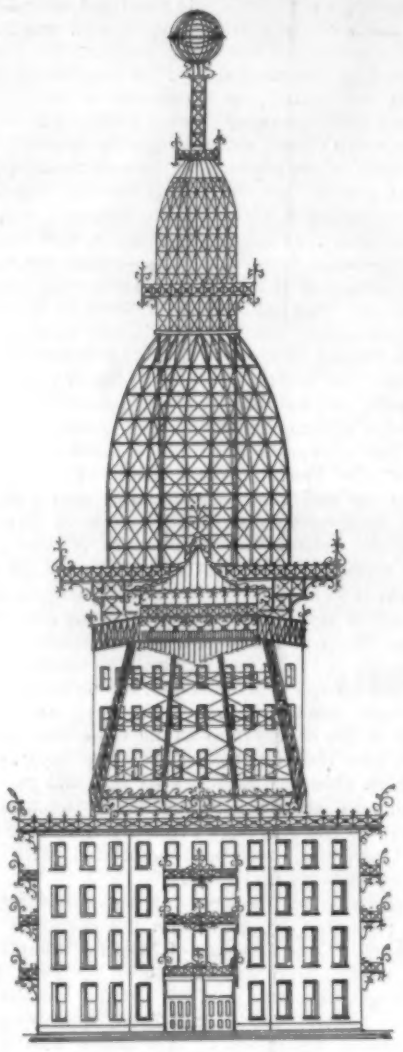
AERIAL SWEEP FOR THE PAN-AMERICAN EXPOSITION.

Visitors to the World's Fair, at Chicago, will remember that the Midway Plaisance was by no means the least successful feature of that great undertaking. Indeed, it was so successful that the lighter and incidental features of the show were charged with exciting more than their legitimate share of attention, to the neglect of bona fide exhibits. However that may be, it is a fact that Ferris wheels, giant swings, exaggerated merry-go-rounds and various Titanic instruments of recreation, do retain their attraction for the general fair-going public, and it is likely that they will long continue to be prominent features at future exhibitions.

We present illustrations of a huge revolving platform to which the name "Aerial Sweep" has been given by its designer, Mr. L. A. Dietrick, of this city. It is designed to be erected upon the grounds of the forthcoming Pan-American Exposition at Buffalo. It consists of a tower, partly octagonal and partly circular, rising to an extreme height of 378 feet, upon which is supported at about its mid-height, a vast rotating platform, which will be 78 feet in width at the tower and will measure nearly 500 feet in length. The first section of the tower will be octagonal in plan, and will measure 150 feet in diameter. It will contain four 20-foot stories and will rise to a height of 80 feet above the ground. At this level the tower will be reduced to a circular form with a diameter of 78 feet, the height of this section being 64 feet. At the top of this second section, 144 feet above the ground, will be located the rotating platform or "sweep," which will be built of light steel trusswork and will extend in opposite directions 240 feet from the center of the tower. Its extreme width will be 78 feet at the tower and 45 feet at the outer ends, on each of which there will be erected a two-story bandstand. It will rotate upon a circle of 12-inch steel balls contained between cast-steel cones, which will encircle the upper section of the tower. The ends of the platform will be supported by trussed steel struts, which will extend from the base of the circular tower to a connection with the framework of the platform. The struts are stiffened by a system of lateral bracing consisting of lattice girders and tie-rods. They foot against a massive circular ring, which encloses the base of the tower, and the thrust is received by heavy ball-bearings which run in a cone bolted around the tower at this point. At the top of the large dome-like extension of the tower, and at a point 110 feet above the platform, there will be placed a collar provided with ball-bearings, and to the collar will be attached wire cables which will extend down to the outer ends of the platform. The trusses of the platform will be connected with this cable by means of vertical suspenders. A system of the cross cables will be introduced to steady the platform and give it the necessary rigidity. The platform, in addition to the two bandstands at each end, will provide a 20 foot promenade which will extend entirely around it, affording a continuous walk of nearly 1,000 feet. The inner side of the promenade will be lined with seats looking outward, while a light, close, steel railing will be built around the outer and inner exposure of the promenade.

The whole exterior of the structure below the level of the platform will be covered with ornamental staff work and will be liberally lighted with windows. The nine stories of the interior will be floored over, giving an aggregate floor space of 120,000 feet which will be used for exhibition purposes. There will be eight elevators for the service of various stories, while one elevator will carry visitors to a platform 140 feet above the sweep, or about 300 feet above the ground line. The structure of the octagonal tower will extend 50 feet above this platform and will carry a 16-foot ball in which will be placed a 2,500-candle power electric light. The whole structure will be highly ornamented and an elaborate system of electric illumination will be afforded by the 12,000 incandescent lights with which the structure will be covered. The rotation of the platform will be accomplished by means of a circular rack and pinions operated by electric power.

Each column foundation will consist of a large mass of concrete, upon which will be placed heavy base plates, 4 feet square, upon which will be erected the vertical steel posts that carry the structure. Particular attention has been paid to the system of lateral and wind bracing, which has been designed to meet the maximum wind pressures that are likely to occur in the locality of the Exposition.



END ELEVATION.

END VIEW OF ROTATING PLATFORM.

A SIMPLE COMPASS WITH A CALIPER-SCALE.

A patent has been taken out by Leslie Young and John L. Ryan, for a compass in which a pencil constitutes one leg, and which is provided with a scale for indicating a distance between the pencil and the pivot-leg. The inventors have assigned part of their interest to Patrick F. Lynch, 2152 Fulton street, Brooklyn, New York city.

The pencil is surrounded by a tapered longitudinally-split sleeve, which can be clamped tightly into engagement with the pencil by means of a clamping-ring. A collar also surrounds, and moves on the pencil. The upper end of the pivot-leg of the compasses, bent at right angles to the body, is pivoted to a lug on the collar. The upper end of the pivot-leg is, furthermore, connected with a lug on the sleeve. To a second lug on the sleeve an adjusting-screw is attached, which passes through openings in lugs formed on the collar. Between the collar-lugs is an adjusting-nut. From the engraving it will be seen that the lugs through which the screw passes are opposite those to which the metal leg and its link are pivoted.

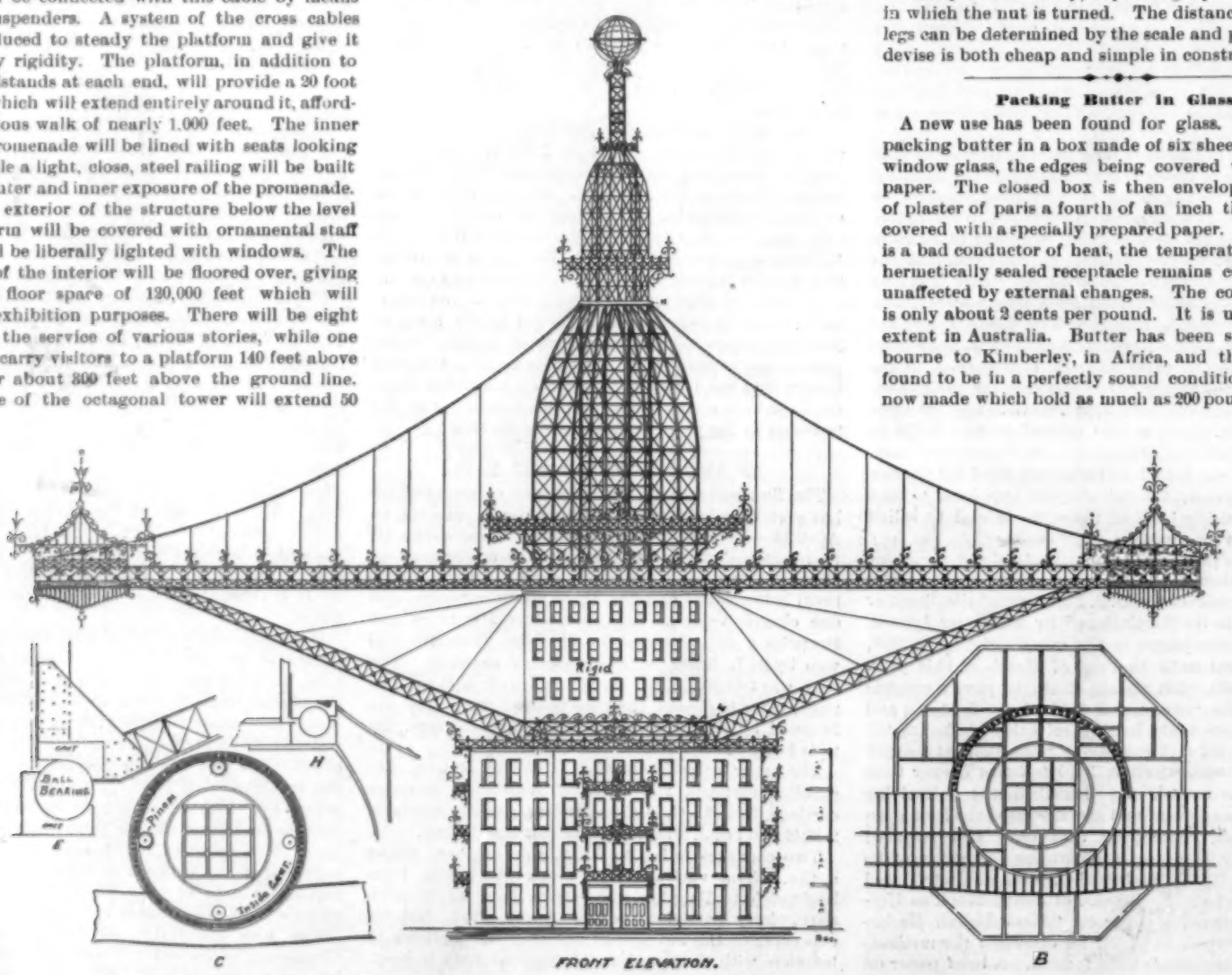
A SIMPLE COMPASS WITH A CALIPER SCALE.

A caliper-scale extends down from the sleeve and moves between two guides, one of which is made in the form of a pointer playing over the scale.

When the adjusting-nut is turned, the collar is moved on the pencil, thereby causing the pivot-leg to move inwardly or outwardly, depending upon the direction in which the nut is turned. The distance between the legs can be determined by the scale and pointer. The devise is both cheap and simple in construction.

Packing Butter in Glass.

A new use has been found for glass. It consists in packing butter in a box made of six sheets of ordinary window glass, the edges being covered with gummed paper. The closed box is then enveloped in a layer of plaster of paris a fourth of an inch thick, and it is covered with a specially prepared paper. As the plaster is a bad conductor of heat, the temperature inside the hermetically sealed receptacle remains constant, being unaffected by external changes. The cost of packing is only about 2 cents per pound. It is used to a great extent in Australia. Butter has been sent from Melbourne to Kimberley, in Africa, and the butter was found to be in a perfectly sound condition. Cases are now made which hold as much as 200 pounds of butter.



FRONT ELEVATION.

TOWER AND ROTATING PLATFORM DESIGNED TO BE ERECTED AT THE FORTHCOMING PAN-AMERICAN EXPOSITION.

Height of tower, 378 feet. Length of platform, 480 feet.

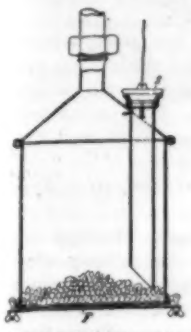
THE USE OF ACETYLENE IN RAISING SUNKEN VESSELS.

The simplest method of raising sunken vessels consists in using the buoyant force of the air contained in casks hermetically sealed. When, however, the work of floating a ship is unusually arduous and difficult, special apparatus must be employed. Metallic reservoirs then take the place of the casks, which reservoirs are filled with water, submerged, and afterward pumped out and filled with air.

Would it not be a far simpler plan, asks a writer in La Revue Générale de Chimie Pure et Appliquée, to obviate the necessity of employing heavy and bulky liquids to sink the reservoirs, complicated pumping machinery and auxiliary apparatus, and a labyrinth of pipes which increases in intricacy with the depth to which the reservoirs are submerged, by generating the necessary buoyant gas below water?

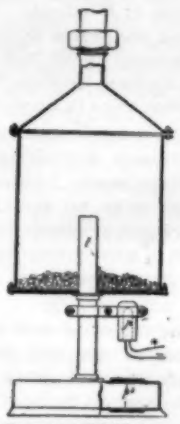
When the possibility of manufacturing calcium carbide on a larger scale was assured, experiments in this direction were made by a French engineer, L. Matignon, these have been so successful that a company has been formed for the purpose of using acetylene in raising sunken vessels.

For the casks and reservoirs previously mentioned, stout rubber bags are substituted, which, when not in use, take up but little room. Before submersion they are covered with a netting, from which a bar or beam is suspended. To the bar chains are lashed which run under the bottom of the ship. The bags are connected by means of pipes with acetylene generators.



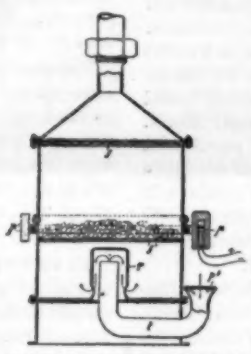
Acetylene Generator with Simple Valve.

Fig. 2.



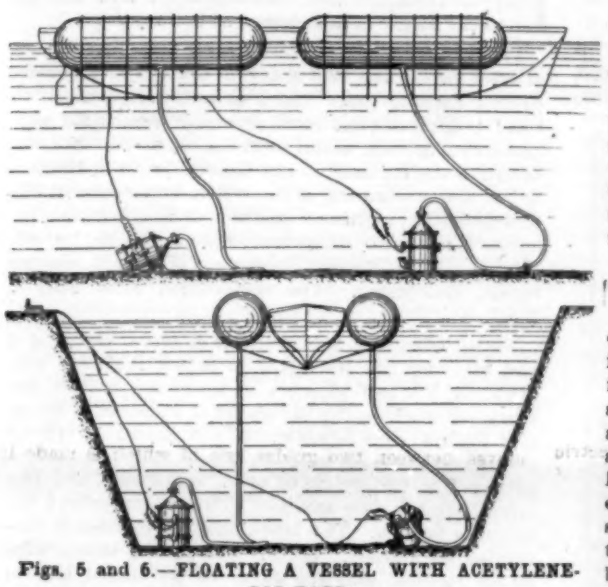
Generator with Electric Starting Device.

Fig 3.



Modified Form of Generator with Electric Starting Device.

Fig. 4.



Figs. 5 and 6.—FLOATING A VESSEL WITH ACETYLENE-GAS BAGS.

The generator, illustrated in Fig. 2, was the first form used, but was soon supplanted by a more improved apparatus. This original generator consisted of a sheet-iron tank, *F*, in which the carbide was contained. Water was supplied by means of the valved pipe, *s*. The valve itself was controlled from the surface by means of a cord. The difficulty experienced in operating several generators simultaneously led to the adoption of the system pictured in Fig. 3.

In this apparatus the gas outlet serves also as a means for introducing carbide and for cleaning the interior. When the leaden diaphragm, p^1, has been perforated by the discharge of the electric detonator, *p*, water rushes through the pipe, *t*, and enters the tank.

The detonator consists of a bronze cylinder, recessed to form a cavity, closed at one end. A cartridge is contained in the cavity, composed of paraffined paper and fitted with the terminals of two electric conductors, connected by a fine platinum wire embedded in a small charge of powder. When a current of sufficient strength passes through the conductors, the platinum is heated to incandescence and discharges the powder. Any other electric detonator can be used, but the cartridge described possesses the merit of simplicity. A battery of accumulators or of Leclanché cells is employed to explode a series of ten detonators.

The apparatus, illustrated in Fig. 4, is an improvement on the Matignon device, because it permits the removal of the hydrate of lime and prevents an excessive pressure of gas. An electric detonator, *p*, counterbalanced by a weight, *p'*, is also used. The lead plate, p^1, is pierced, as before, by the discharge to admit water to the carbide.

The Prevention of Dust in Mines.

The appalling results of explosions and the dangers of dust in mines and other places being recognized, and extended knowledge having been gained by recent experiments and observations, the highest importance may be attached to the prevention of accumulation and methods devised for decreasing the danger. It is admitted and proved beyond doubt, where explosions have taken place, that the explosive force and the flame is most destructive in the main galleries where the newly made dust is being continually carried. The results of the experiments show that we must treat mines where the element of dust is found with as much care as a powder magazine. Many attempts have been made to water or damp the dust lying on the roads, walls and chambers in coal mines. An arrangement has been perfected for lightly wetting the coal and dust on the top of each tub as it leaves the siding in the mines where the engine setts run at a high rate of speed against strong currents of air and the same arrangement can be applied to dust at the screens and coal stores, and to pulverized coal to be sent to coke ovens, where explosions and accidents have taken place from dusty coal. A newly devised method for obviating and diminishing the risk of loss from coal-dust explosions was described by R. Harle, in a paper read before the North of England Institute of Mining and Mechanical Engineers, and published in Transactions of the Institution of Mining Engineers. The arrangement consists of means for automatically damping each tub so as to prevent the escape of dust and to moisten it to the same extent as in damp mines. In such mines no trace of dust can be found and few explosions (if any), either from shot-firing or dust have taken place and this safety confirms the theory that damp is effectual in mitigating the effect of coal dust explosions. The apparatus is fixed at the outer end of the siding where the tubs are arranged to start on their journey to the shaft. It consists of a perforated pipe or sprayer and allows water to spray over the area of each tub as it passes under the apparatus. The valve of the sprayer may be actuated by wheels passing over a projection in the rails or by some other part of the tub. It has been found in practice that one pint of water sprayed over each tub is sufficient to moisten the dust and prevent it from rising so that a tank containing about 70 gallons is sufficient to moisten an output of about 150 tons per day.

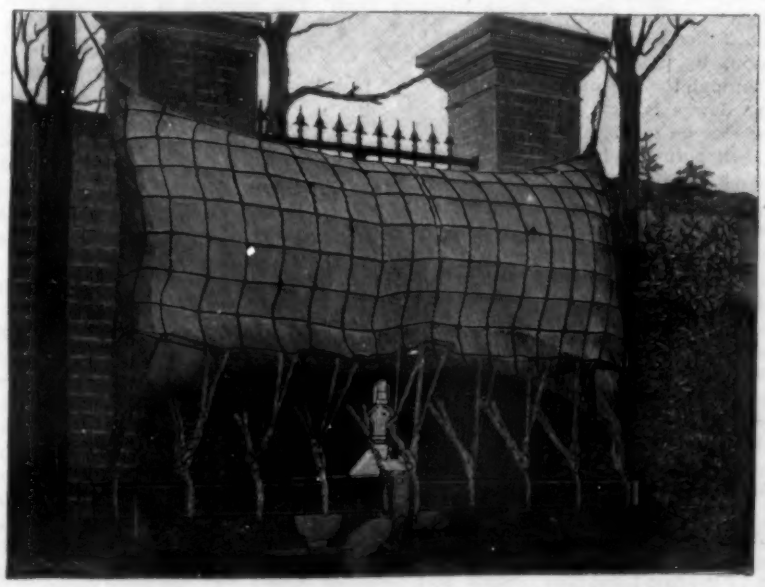
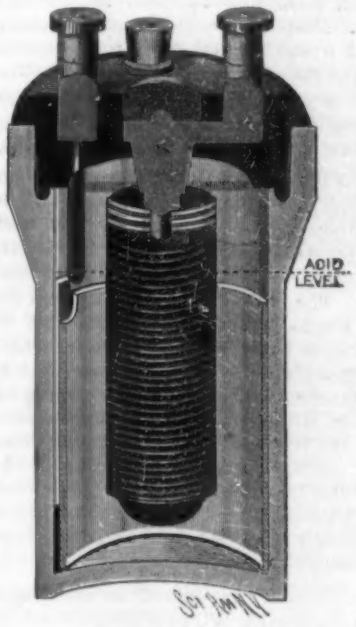


Fig. 1.—RUBBER GAS-BAG CONNECTED WITH ITS GENERATOR.

A NEW STORAGE BATTERY.

A storage-battery has been introduced by the United States Battery Company, of 253 Broadway, Manhattan, New York city, which is remarkable for its high voltage, small weight, and compactness. The battery is of the zinc-lead type, the zinc being made in the form of an amalgamated plate coiled so as to fit snugly against the glass wall of the cell, and the lead element being composed of a great number of spongy, superposed peroxide plates suspended from the insulated and acid-resisting cover of the cell and connected with the positive terminal. The zinc plate is connected with the negative terminal by means of an amalgamated copper rod, offset so as to pass between the plate and the glass wall of the cell. The rod at and above the level of the electrolyte is protected from corrosion by a rubber tube. The jar at the top is formed with a shoulder provided with an annular groove filled with adhesive wax, into which the cover is pressed. The cover is thereby perfectly sealed, and is yet readily removable. The construction prevents the creeping of salts over the edge of the cell, a defect common to many batteries in which zinc is used. Current leakage (common to unsealed accumulators) is likewise prevented. Hitherto an electro-motive force higher than two volts per cell has not been regularly reproduced. The cell in question, however, registers 2·65 volts on a full charge and discharges without fluctuation to 2 volts. The discharge can be carried still further without material injury. By connecting the terminals with a direct electric current, using incandescent lamps or other resistance, the cell can be recharged. The rate of charging, it is stated, is proportionately higher than with most accumulators, and the time required considerably shorter. In a 5 ampere-hour cell, the positive element weighs but 6 ounces. The positive and negative elements, together with the electrolyte weigh 17 ounces, giving an efficiency of 12 watt-hours per pound of battery. The makers claim that the cell is the only accumulator which is made so that it can be carried in stock by dealers in a fully charged condition without deterioration. The cell is shipped fully charged; and is placed in active service merely by pouring in the electrolyte.



A NEW STORAGE BATTERY.

The Temperature of the Ocean.

Sir John Murray, in his Presidential address before the Geographical Section of the British Association, brought out some interesting facts as to the temperature of the ocean at great depths. The data obtained up to the present time shows that at a depth of 180 meters the temperature of the water remains nearly or quite invariable at all seasons. It is estimated that 92 per cent of the mass of water is at a temperature below 4·4° C. Nearly all the deep water of the Indian Ocean is below 1·7° C., this temperature being about the same for a great part of the South Atlantic and certain parts of the Pacific, but in the North Atlantic and the greater part of the Pacific the temperature is higher. For depths beyond 3,600 meters the mean temperature of the North Atlantic is one degree greater than that of the Indian Ocean and a part of the South Atlantic. The mean temperature of the Pacific has an intermediate value. As the depths of the sea constitute an obscure region where the solar rays cannot penetrate, it follows that vegetable life must be absent upon 93 per cent of the bottom.

Science Notes.

A whale has been found with a harpoon in its body which, by its mark, showed that it must have been hurled at the whale at least thirty-six years ago.

Germany is keenly alive to the necessity of a knowledge of the languages of the countries in which they foresee advantages for trade. German commercial schools have asked the Russian Ministry of Finance to aid them in procuring teachers of the Russian language.

The Union Pacific Railway Company is providing its offices in large cities with a mutoscope for displaying some of the interesting points along the Overland route. Six sets of views have been provided, one of them being the Overland Limited going at a speed of a mile a minute.

Monte Baldo, between Lake Garda and the valley of the Adige, in Italy, was once the center of volcanic action, but in the early part of the present century this activity had apparently ceased. Last March, however, an indistinct rumbling was heard in the mountains which seem to come from the interior of the mountain. Deep fissures formed on the crest, whence hot steam is still ejected from time to time, which melts all the snow in the neighborhood. The indications are very similar to the preliminary symptoms which preceded the terrible eruption of Mount Tarawera in New Zealand, some thirteen years ago.

The new Memorial Hall, at the United States Military Academy, at West Point, on the Hudson River, is a gift of Brevet-Major-General George W. Cullum, and is a receptacle of statues, busts, mural tablets, and portraits of distinguished officers and graduates of the academy. The building was built from designs by McKim, Meade and White, and the cost was $250,000. It stands facing the main parade, upon the high bluff overhanging the Hudson River. As a military memorial and museum, it is, as a building and as regards its purpose, without a rival in this country. It is to be made the repository of the most important memorabilia of our wars, as well as a monument to the commanders who have graduated from this school of war, and who have served with the highest distinction in the armies of the United States in every conflict from 1812 to the present day.

Senator Chandler has offered an amendment to the Naval Appropriation Bill providing for civilian control of the Naval Observatory. This is in accordance with the recommendation of many American men of science who consider that this important institution should not be under the control of naval authorities. It is proposed to have as a permanent astronomical force an astronomical director, first, second, third and fourth astronomers, each having an assistant, together with such computers and other employees as are now authorized. A director of The Nautical Almanac would also be appointed. It provides for a board of visitors without compensation, composed of six astronomers and three citizens, who shall annually investigate the institution, and upon whose recommendations vacancies in the staff shall be filled.

It is stated that German surgeons have discovered that the delicate membrane which lies inside of an eggshell will answer as well as bits of skin from a human being to start healing over by granulation, in open wounds which would not otherwise heal. The discovery was used for the first time in this country on a patient in the Seney Hospital in Brooklyn, and the trial of it has been most successful. The surgeons have long known that healing by granulation requires in a weak patient some point or points around which the granulation can cluster and grow. For this purpose they have had to rely upon bits of human skin taken from some person who was willing to submit to the painful process of having these bits cut out. In the present instance the surgeons remembered the German discovery and, getting some fresh eggs, tried the lining membrane of the shell, with the result that it proved to be a perfect substitute.

Some interesting experiments have been carried on in the University of Genoa, with the view of observing the temperature of the animal body during fasting, and the rate of assimilation of carbohydrates. The experiment demonstrated the ability of sugar to raise the temperature of an animal when it has fallen during fasting. When sugar was administered it caused a rapid rise of temperature during the first ten or fifteen minutes, and in one or two hours the temperature will reach a maximum which will be sustained for a period of time depending upon the amount of sugar. This effect is said to be most marked after a long fast, when the temperature is the lowest. Bread has a somewhat opposite effect, as the sugar is more readily assimilated by a starving animal. After bread is given, the temperature will rise, but more slowly than with sugar, and the rise is most rapid with animals whose period of starvation is short and whose temperature is not too low. Prof. Masso states that with sugar he has succeeded in restoring the vitality of dogs which were in a serious condition of hypothermia, while the administration of albumen to others failed to save their lives.

The Electrical Illumination at the Pan-American Exposition.

The electrical illumination at the Pan-American Exposition of 1901 will probably be the most notable achievement in this line in the annals of electrical engineering, in this country, to say the least. The Court of Fountains, which has an area of 850,000 square feet, will be brilliantly lighted without the aid of a single arc light. One hundred thousand incandescent lamps of 8 and 16 candle power will be used, resulting in an illumination highly diffused, and with no intense points of brilliancy—in fact, light without shadows will thus be obtained. The electrical tower which was illustrated in the last week's issue of the SUPPLEMENT will form the center of a beautiful vista. It is 300 feet high and is surrounded by harmonious colonnades. In front and facing the Court of Fountains is a niche 70 feet high and 30 feet wide. There will be an extensive water display in this niche, consisting of individual drops of water subjected to elaborate electrical effects. Each drop will, as it were, become a prism permeated with color. Surrounding the electrical tower is a basin 90,000 square feet in area. In front of the niche will be an illuminated cascade, the waters of which finally flow into the basin, where there will be numerous pieces of allegorical statuary rising from the water.

Designs are also being developed for electric fountains to embellish the interior courts of several buildings; also for the illumination of the Grand Canal over its course of several miles. Floating attractions will form a point of interest on the great lake called the "Gala" Water.

A WINDOW MIRROR.

Our illustration represents a simple contrivance, invented by Mr. Oscar Hillstrom, Sedgwick and Lind Aves., New York city, by means of which it is possible

THE HILLSTROM WINDOW MIRROR.

to observe what is passing in the street without opening the window.

The device is a reflector made in the form of a pyramid, the four sides of which are lozenge-shaped mirrors. The reflector is supported at the side of a window by means of an arm, which can be fitted either in a socket formed on a web extending across the base of the reflector, or in registering openings formed in the web and in the apex of the pyramid.

If the arm be inserted in the socket of the web, the reflector is held so as to enable one to see objects or persons at each side of the window, as well as above and below the window. In Fig. 2 the reflector is shown placed in a vertical position, by passing the upper end of the supporting arm through the openings in the web and apex. When the device is thus arranged objects above the window can be seen. The reflector can be placed with its apex pointing down, merely by reversing it from the position shown in Fig. 2. When the contrivance is thus mounted, objects below the window are reflected into the room. If the device be arranged as first described, the opening in the apex is closed by a rubber stopper, which serves as a fender to prevent the breaking of the mirrors or of the window-pane.

The reflector, it is evident, can be used in armories and towers, the grilled windows of which are so narrow that it is usually impossible to see objects at either side.

A HORSE race in Venice seems to be an absurdity for the only horses she possesses are the bronze ones in front of her great Basilica of St. Mark's. Venice is, however, to have a race meeting this year and a considerable sum has been raised. A race course is being laid out on the Campo di Marte, the old drill ground near the railroad station. It will be the first horse race Venice has ever seen.

Engineering Notes.

The London and Northwestern Railroad Company has just completed its four thousandth locomotive at the works at Crewe, and it will be sent to Paris to the Exposition.

A writer in a Russian journal estimates that to reach the level of other European countries, Russia would have to construct 53,000 additional miles of railroads, not including Siberia, in order to have the length of its railways commensurate with the population.

Three Prussian officers have made a quick trip from Berlin to Prague in a balloon. They left at 2 o'clock in the afternoon and came down at 5 o'clock, having risen to an altitude of 10,000 feet during a part of the journey. The distance between the two cities is covered by an express train in seven hours.

The Ferris wheel which was one of the great attractions at the Chicago Exposition, and which was reerected at Wrightwood Avenue and North Clark Street, Chicago, is to be removed. It is estimated that the cost of the removal will be $30,000 and if a bid is not made in a short time the receiver of the company will be compelled to sell it as scrap iron and steel.

In view of the increased cost of traffic through the advanced prices in coal and iron, the railway companies of England have decided to raise the excursion fares during the ensuing holiday season. Fares up to five shillings will be advanced by three pence over that sum, and up to ten shillings by six pence, and on fares over that amount, by one shilling. The new scale will apply to both day and half-day trips, and also to tickets for longer periods issued at holiday rates.

The Scottish Paper Makers' Association offers a prize of $500 for (A) the best study of the lye obtained in boiling Esparto grass and a quantitative analysis of this lye; (B) best practicable process of separating and preserving in some useful form the waste material obtained in the manufacture of Esparto products (Esparto lye, fiber containing drain water, lime residue); (C) commercially practicable method of utilizing the recovered material. Communications are to be addressed to G. Munro Thomson, W.S., 123 George Street, Edinburgh. The competition closes July 1, 1900.

Notwithstanding the fact that a truck carrying a new cable for the Metropolitan Street Railway Company, (N. Y.), had wheels with tires 8 inches wide, the truck got stuck on the car tracks at Fourteenth Street and Fifth Avenue recently. It was drawn by thirty horses and the cable weighed 32 tons. The horses were arranged in two strings of seven spans each, and two large Normans were attached to the wagon pole in the ordinary fashion. The truck finally succeeded in continuing its journey. Loosely laid paving stones were either jammed into the earth or pulverized and in many places the grooves were left in the street.

Flexible metallic hose is recommended in preference to india-rubber hose for mining purposes. The hose is formed of a metal band rolled up like a screw thread, the specially profiled edges of the band engaging in one another so as to form a continuous joint; and a cord of india-rubber or asbestos depending upon the use to which the hose is to be put, is entirely enclosed by the metal and fills up the space between the edges, making a continuous tight joint, while the metal pipe has considerable flexibility. Galvanized steel and phosphor-bronze are chiefly used, and pipes are made for any pressure up to 3,000 pounds. Careless handling is apt to cause leakage, but this is counteracted by making the hose double, the winding of the inside and outside portion being in contrary directions.

A novel scheme for impounding débris in the Yuba River, in California, has been worked out, mainly by Assistant Engineer Hubert Vischer, says The New York Evening Post. The problem of governing vast quantities of eroded detritus in torrential streams was practically new, the California papers claim, about the only former attempt in this line being at the headwaters of the Rhine, where denudation of soil made trouble for Swiss peasants like that sought to be remedied in California. In the Yuba the coarse material is to be held by long and comparatively low dams at different points, but the most novel feature is that to take the fine sediment out of the water. There is to be a settling-basin three miles long into which the river will all flow at ordinary stages. If the water poured out in a stream at the lower end, the currents would prevent much settling. So Mr. Vischer has devised a scheme to make the water percolate through eight pyramidal structures of logs, planks, cement and cracks. The water will flow through a great number of half-inch (or less) slits from all sides of the pyramids, which are to have seventy-foot bases and are to be strung across the basin. The flow can thus be regulated and currents avoided. This basin is calculated to hold 14,000,000 cubic yards of fine sediment, and can be enlarged to hold 50,000,000 cubic yards more. The estimated cost of the work is $800,000, and $500,000 of State and national money has been available since 1896, awaiting a practical solution of the problem.

THE HYDRAULIC SYSTEM OF AIR COMPRESSION.

There are some inventions which appeal to one's mechanical instincts at the very first sight, the principles upon which they are based being so perfectly sound, and the mechanical means adopted to achieve the desired results so admirably chosen, that the device carries its own credentials. Of this character is the new system of air compression illustrated upon the front page of this issue, which has been in successful operation for the past two years at Magog, Quebec, where it has shown very economical results. In speaking of the system as new, we are aware that its principles are old, being found in the water-blast of the ancient Catalin furnace; but we believe this is the first time that hydraulic air compression has been successfully applied in competition with the other well-known systems of air compression.

We are all familiar with the methods commonly adopted in which the work is done by compressors operated by steam or some other suitable power. One of the latest air compressing plants of the standard type is that erected to furnish compressed air for the crosstown cars of the Metropolitan Street Railway Company. This plant, which was illustrated in the SCIENTIFIC AMERICAN, of September 16, 1899, may be taken as representative of the most advanced state of the art where steam compressors are used. The air is compressed in four stages, with cooling between each compression. The intermediate cooling is necessary to keep down the temperature of the air and deliver it to the storage tanks at the desired temperature and pressure for use on the line. A plant of this kind is necessarily complicated and costly.

The hydraulic air compressor, as herewith illustrated, is very simple in its construction, all that is required being the provision near a suitable waterfall of a vertical shaft, a large vertical iron pipe, and two receiving tanks, one at the top and the other at the bottom. Beyond the slight repairs which may be necessary after a considerable lapse of time, there is practically no expense for operation, and the system once started will run uninterruptedly, the plant which forms the subject of our illustration having been in continuous operation, day and night, since it was first started, more than two years ago. The expenses for repairs and attendance have been absolutely nothing during this period.

This plant, which is situated at Magog, Quebec, was installed to furnish power for the printing works of the Dominion Cotton Mills Company. The head of water is 22 feet, and a series of tests made by Prof. McLeod, of McGill College, Montreal, showed that 100 horse power is being delivered with a hydraulic efficiency of 70·7 per cent. The water is conveyed through the penstock, *A*, to the upper tank, *B*, which is known as a receiving tank, where it rises to the same level as the original source of supply. Projecting upwardly through the bottom of the receiving tank is the compressing or downflow pipe, *C*, which is 44 inches in diameter. The pipe extends down through a vertical shaft or well, *E*, which measures 10 feet by 6 feet in section, and is 128 feet deep. At the bottom of the shaft the compressing pipe enters a large tank, 17 feet in diameter by 10 feet in height, which is known as the "air chamber and separator." The water flows through the penstock, *A*, and the pipe, *C*, to the air chamber, *D*; out under the lower edge of the air chamber and then up through the vertical excavated shaft to a final discharge through the tailrace, *F*. Suspended above the flaring mouth at the top of the down-flow pipe is a head piece, *J*, which consists of a bell mouth casting, *b*, opening upward, a cylindrical and conoidal casting, *c*, and a circle of small vertical air supply pipes, *d*, each of which has, at its lower end, a number of small air inlet pipes, extending from it toward the center of the compressing pipe. The head piece is raised and lowered by means of a hand wheel and a screw, *f*.

The supply of water to the compressor is governed by the depth to which the head piece is lowered into the water, the water entering the compressing pipe by way of the annular and variable opening, between the two castings, *A* and *B*. As it enters the compressing pipe it flows among and in the same direction as the small air inlet pipes, *D*, and produces a partial vacuum, with the result that the atmospheric pressure drives the air through the air space into the inrushing water in innumerable small bubbles, which are carried by the water down the compressing pipe. As the bubbles descend they are subjected to a pressure due to the hydraulic head, the final pressure when they reach the bottom of the pipe being, of course, proportional to the column of return water in the shaft, *E*, and the tailrace, *F*.

The reduction of volume and increase of pressure of the air bubbles is shown in the diagram on the front page, the volume decreasing from 1 to ·227, with an increase of pressure from 0 to 50 pounds to the square inch. At the bottom of the compressing pipe is arranged a circular table or diaphragm, *K*. Equivalent to the "altar" of the old "trompe," or water blast, called the disperser, and in its center, immediately below the pipe, is another conoidal casting which serves to change the direction of the flow of water and air from the vertical to the horizontal, directing it toward the circumference of the separating chamber, *D*. After flowing over the edge of the disperser, the water is conducted back to the center by the action of an apron, *L*, and then returns again toward the circumference, finally passing beneath the bottom of the air chamber and rising through the shaft to the tailrace, *F*. During the passage of the water through the separating tank, where its movement is slow compared with the vertical motion in the compressing pipe, the air, on account of its buoyancy, rises through the water and collects in the upper part of the air chamber, as shown, such of the air bubbles as are carried beneath the table, *K*, escaping to the upper part of the air chamber through a series of pipes, *M*. The air in the chamber is kept at nearly uniform pressure by the weight of the water in the shaft and tailrace. The compressed air is led from the air chamber through the vertical pipe, *I*, to an automatic regulating valve, *P*, and from this it is carried to the engines, or, if the power is to be used at a distance, a connection is made at *P* with the pipe line.

The pressure of air in the separating chamber is 0·43 pounds on the gage for each foot of difference in level between the surface of the water in the tailrace and the level of the surface of water in the separating chamber. As the air space in the separating chamber of the largest plant is not likely to exceed 10 feet in depth, the variation of air pressure, as this fills or empties of air, will not exceed four pounds to the square inch.

The hydraulic system of air compression has a distinct advantage in the fact that the compression is isothermal. One of the chief difficulties in the compression of air by the usual methods is connected with the increase of temperature due to compression and to the condensation of water vapor. This condensation may be due either to a fall of temperature or an increase of pressure, or both. The heat of compression is one of the permanent, non-recoverable, losses which must be written down against the ordinary method of compressing; for the heat which is lost by radiation represents a large part of the work done in compression, and no serious effort has been made, and probably no successful effort ever will be made, to recover the heat which is now carried away in the cooling water of the cylindrical jackets and intermediate coolers of the ordinary systems. In the hydraulic air compressor the bubbles of air during their passage down the compressing pipe are kept cool by the body of water which surrounds them.

As the bubbles take from 10 to 25 seconds to descend, according to the depth of the pipe, the process of compression is rather slow, and the temperature of the water is scarcely affected by the heat that it absorbs from the air during its compression. The air bubbles, therefore, are compressed at a constant temperature, and the excess of moisture due to the increasing pressure is deposited on the walls of the bubble as it descends. Hence, by the time the air is collected in the separating chamber, it carries the low temperature of the water and is practically free from moisture.

A series of tests made shortly after the first plant was put in operation showed that 100 horse power in air was being delivered with an efficiency of 62·4 per cent. The number of air inlet pipes was then increased, with the result that an efficiency of 70·7 per cent was obtained. It is believed that the diameter of the separating chamber is at present too small, with the result that 20 per cent of the air that is compressed fails to separate and is retained and carried away by the water up the shaft. It is expected that with an enlarged chamber the plant will show a hydraulic efficiency of over 82 per cent. It is claimed by the designer that the best turbine and mechanical compressor will not give an efficiency from water to air of over 55 per cent.

The second hydraulic air compressor to be installed, is located at Ainsworth, in the Kootenay mining district of British Columbia. The compressed air in this case is to be transmitted about four miles, and distributed among the silver lead mines of that locality. The compressing pipe in this case is 29 inches in diameter, and the air pressure obtained is 85 pounds to the square inch. In another plant which is now being constructed at Peterborough, Ontario, a gage pressure of 25 pounds to the square inch will be realized. The plant which is being constructed at Norwich, Conn., will give 1,365 horse power, at a pressure of 85 pounds per square inch, the depth of the shaft in this case being 203 feet and the diameter of the compression pipe, 13 feet. The air will be transmitted to a distance of four miles. The first tests of the efficiency of the Magog plant were made by C. H. McLeod, Professor of Civil Engineering, of McGill College. We are informed by Mr. Charles H. Taylor, who is the inventor and patentee of the system, that it is proposed in the future to increase the efficiency of the compressor by a system of heating the air prior to expanding it in the motors.

We are indebted to Mr. John A. Inslee, of the Continental Compressed Air Power Company, Philadelphia, for courtesies extended in the preparation of this article.

Automobile News.

There are 5,207 motor cycles in France on which the annual tax has been paid, says The Automotor Journal.

An automobile recently covered the distance from Coventry to London, 92 miles, in four hours, this being an average of 23 miles an hour.

The Assembly Committee on Judiciary of the State of New York, has reported the bill of Assemblyman Apgar, of Westchester County, which is intended to prevent the reckless operation of automobiles. To reach this end the measure provides that no one shall run an automobile without a license procured from a specified examining board. One dollar is to be charged for an examination and $2 is added for the issuing of a license, which may be revoked upon satisfactory proof of drunkenness, incompetency or reckless driving of the licensee.

An automobile show will be held in Madison Square Garden the first week in November. It will be held under the auspices of the Automobile Club of America, and will be the first exhibition of automobiles on a large scale ever held in this country, and it is expected that vehicles of European manufacture will be included in the exhibit. A circular track will be provided in the Garden, so that various types of automobiles can be shown.

The Automobile Club of London will have a motor car trial from April 23 to May 12, the course being 1,000 miles. The course is from London to Edinburgh and return, and includes one-day exhibits at Bristol, Birmingham, Manchester, Edinburgh, Newcastle-on-Tyne, Sheffield, and Leeds, and shorter exhibitions at other places. A number of prizes will be offered, and it is expected that a large number of motor carriages of various classes will participate.

The Baltimore and Ohio Railway Company, has established an automobile service at Washington, D. C., in connection with their trains. This is believed to be the first railroad to introduce this means of transportation regularly to and from a railroad station. An electrical system is used. Two small trunks can be carried on supports on each vehicle and additional baggage can be placed upon the top. As the streets in Washington are in very fine condition there is every prospect of the service being successful.

A party of Frenchmen are to attempt to reach the Klondike in an automobile. They are to take with them a Bollée carriage in which the rear driving wheel is spiked and the front wheels are taken off and replaced by runners. We have already illustrated a Bollée carriage which has been metamorphosed in this way. The car will draw a sledge carrying 250 liters of petroleum spirits, and a motor tricycle which will be used for assisting the carriage when necessary. The usual means of transport to Vancouver, Skagway and Lake Bennett will be used, from which point the horseless carriage journey will begin. It is very easy to prophesy the ultimate fate of the carriage.

Two of the largest traction engines in the world and eight steel carriages for use in the mining district of Siberia were shipped, March 15, from San Leandro, Cal. There has also been planned a carrying service across the desert in China in competition with the trade now done by means of camels. It is "said" that the camels can carry only about 600 pounds each and make only 20 miles a day, while traction wagons will carry ten tons each and can make 60 miles. It is expected to have 50 engines and 3,000 wagons actively engaged within a year. An agent is now at Bucyrus, Ohio, says The Railway Review, purchasing the first installment of 10-ton traction wagons and engines with which to haul them.

A decision of considerable importance was rendered on appeal at Rochester, New York, by Judge Sutherland. The circumstances were as follows: The inventor of a gasoline carriage was sued by a tradesman for damages, due to a runaway caused by the horseless vehicle. Judgment was given to the plaintiff, and the defendant appealed the case, with the result that the judgment was reversed. The Court said: "If one should find it desirable to go back to primitive methods and trek along a city street with a four-ox team and wagon of the prairie schooner variety, it would possibly cause some uneasiness in horses unused to such sights. Yet it could not be actionable, in my opinion, if a runaway should result, provided due care were shown not unnecessarily to interfere with the use of the highway. Horses may take fright at conveyances that have become obsolete, as well as those which are novel; but this is one of the dangers incidental to the driving of horses, and the fact cannot be interposed as a barrier to retrogression or progress in the method of locomotion. Bicycles used to frighten horses, but no right of action accrued. . . . The temporary inconvenience and dangers incident to the introduction of these modern and practical modes of travel upon the highway must be subordinate to the larger and permanent benefits to the general public resulting from the adoption of the improvements which science and inventive skill have perfected."

THE VAGARIES OF A RAILROAD WRECK.

We present a photograph of a recent railroad wreck which, on account of the curious effects of suddenly arrested momentum which it portrays, is worthy of something more than a passing mention. In a recent issue we gave an illustration of a collision which resulted in a locomotive climbing onto the platform of a 50,000-pound freight car, which stood up so nobly under the burden that it was utilized to carry the wrecked engine to the nearest repair shop. It is decidedly interesting to study photographic views of railroad collisions with a view to noting what is the least line of resistance along which the momentum of the train exerts itself. As a rule the direction is a lateral one, the cars usually spreading [to the right and left; but occasionally the line of least resistance lies in a vertical plane, and one train will mount the other, as in the case we illustrate. In other collisions, conditions of resistance are so well balanced that the two trains pile up into an indistinguishable mass of wreckage.

The accompanying photograph, which was furnished us by Mr. G. F. Belknap, of Chicago, present a wreck which occurred early in the year at South Whitely, Indiana. It seems that as a freight train was approaching the town, the couplings gave way about a mile and a half before the station was reached, and the engineer carried the forward half of the train into the yard without being aware of the accident. On discovering that half of the train had been left behind, he attempted to back his train onto the side track. The rear half of the train, however, had gathered speed on a down grade some distance back from the station and was following the forward half at a speed of about ten miles an hour, the two halves of the train colliding before the side track was reached. In the center of the train was a freight car loaded with lumber, and immediately behind it were the three box cars which will be noticed in the photograph mounted upon the cars in front. Evidently, when the crash came, the first of these cars mounted the platform of the car ahead and pushed the loose lumber into the form of a rude inclined plane or runway, over which this box car and the two immediately following it slid without any serious damage to themselves. The trucks, with one exception, were left behind on the track, the body of the cars simply sliding clear of their trucks onto the lumber car and over the pile of lumber to the cars ahead. Our correspondent informs us that the cars were so little damaged that "you would never know they had been in a wreck." In the center car there were three stockmen, whose escape was due, no doubt to the extemporized inclined plane ahead of them.

VAGARIES OF A RAILROAD WRECK.

A PATENT has been taken out by a Boston inventor for the combination of an additional air port with the Westinghouse engineer's brake valve, by the use of which an automatic flow of sand to the rails is insured whenever an emergency application of the air brake takes place. The sanding of the track is most important when the brake must be applied quickly, and it is desirable that every part of the brake be operated by one motion on the part of the engineer.

THE NEW JAPAN BATTLESHIP "SHIKISHIMA."

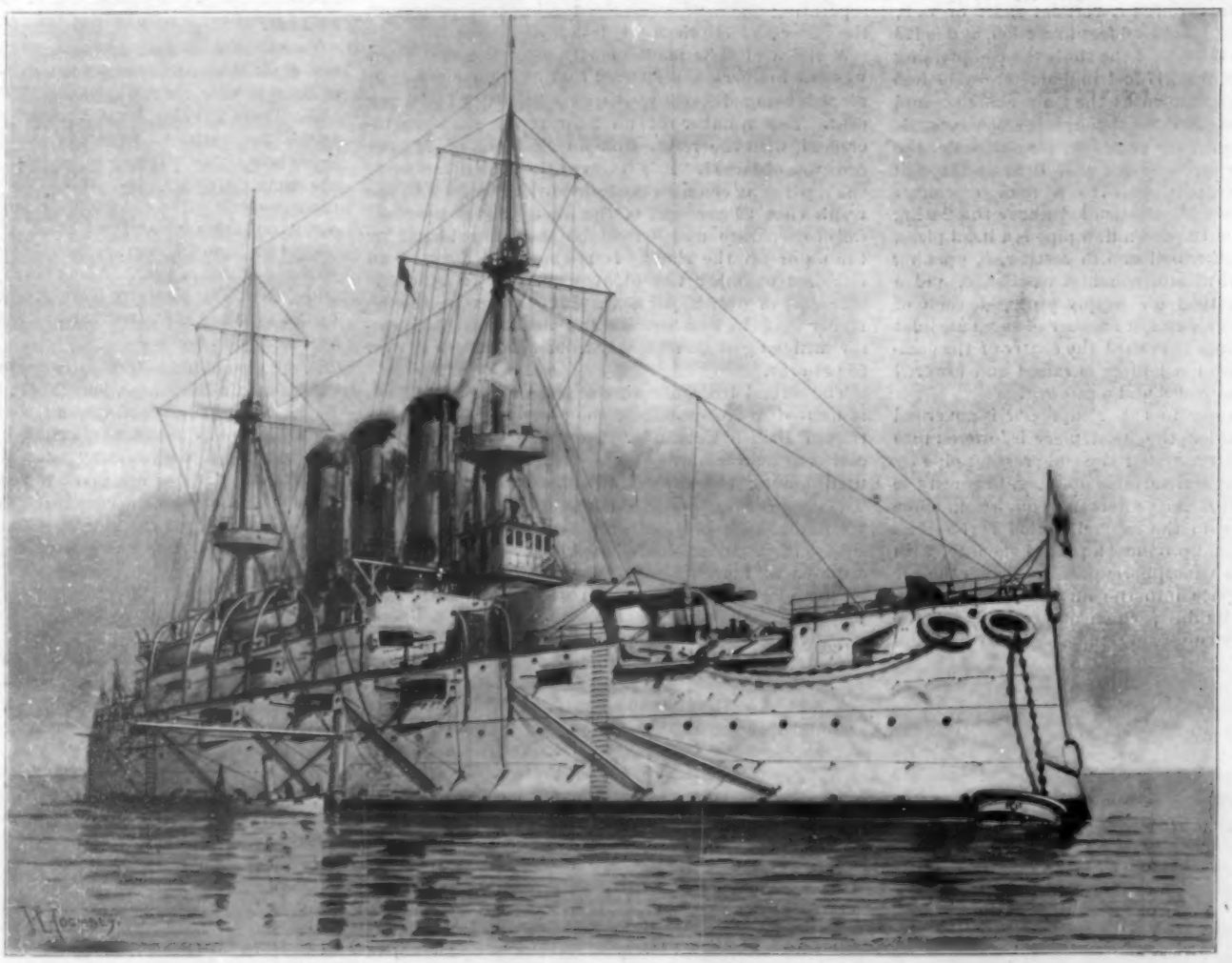
Japan has given many evidences during the closing years of the century of her determination to stand in the very fore-front of civilization. A striking evidence of this is afforded in her naval and military affairs, in which she has shown herself alive to every improvement which has been made in the materials of war.

From occupying practically no rank whatever as a naval power, in a few years she has developed a navy which is so thoroughly efficient, so essentially modern, that it should be invariably included in any list of the leading navies of the world. Ever quick to note the latest trend of design and construction, Japan has realized the value of size, speed and power, both for attack and defense, and has wisely, as it seems to us, put the bulk of her naval displacement into ships of great size, high speed and powerful batteries. Moreover, she was one of the first nations to realize that the first line of defense must consist of ships of the armored class, and in accordance with conviction, the latest additions to her navy have consisted mainly of powerful battleships and large armored cruisers.

Concrete evidence of the truth of the above statement is found in the fact that her fleet includes six thoroughly modern battleships which range in displacement from 12,300 to 15,000 tons, while none of these vessels has a speed of less than 18 knots an hour. At the same time there are now either building or completed six powerful armed cruisers of between 9,000 and 10,000 tons of 21½ knots speed. This is a remarkable showing for a nation which may be said to be just emerging from semi-barbarism, and which less than half a decade ago did not reckon a single modern armored ship among her fleet.

We present an illustration of the "Shikishima," which recently sailed for Japan from the yards of the Thames Shipbuilding Company, where she was constructed. She is probably the largest warship afloat. With an over-all length of 438 feet, and an extreme beam of 75 feet 6 inches, she displaces on her mean draught of 27 feet 3 inches, nearly 15,000 tons. With a complete equipment of stores, and carrying her maximum coal supply, the displacement of this great ship must be considerably over 16,000 tons. She is essentially a typical modern battleship, with a decided approximation to the English school of design as represented by the present Chief Constructor of the English navy, Dr. White; although perhaps, it would be still nearer the truth to say that she is a modified Armstrong design, such distinctive features as the vessel possesses having in them a suggestion more of the extreme Armstrong ship than of the more moderate vessels turned out by the English government designers.

The armor throughout is of Harveyized nickel steel. The water line belt is 8 feet 2 inches deep, and is continuous from stem to stern, tapering in thickness from 9 inches amidships to 4 inches at the ends. Above the main belt is an upper wall of 6-inch armor, which extends between the main barbettes, a distance of 250 feet. Between the end of this armor and the barbettes are screen bulkheads of 6-inch armor. Below these 6-inch bulkheads are heavy 12-inch bulkheads, which extend also from the main barbettes to the side of the ship. The armored deck is located 2½ feet above the mean water line, and slopes at the sides to a junction with the lower edges of the main belt. On the flat it is 2 inches in thickness, and on the side-slopes, 3½ inches thick. That portion of the main deck which is within the central citadel of 6-inch armor is 1 inch in thickness. The barbettes are protected with 14 inches of armor, and they extend to a height of 4 feet above the upper deck. The main armament consists of four 12-inch 40-caliber rifles, two in each barbette, protected by 6 to 8-inch shields. The intermediate battery consists of fourteen 6-inch rapid-fire guns, which are mounted within casemates on the broadsides, eight of them on the main deck and six on the upper deck. All of these casemates are protected by 6-inch armor. The two 6-inch guns at each end of the upper deck battery are capable of being trained parallel with the keel of the ship, thus giving a concentration of two 12-inch and two 6-inch rifles both ahead and astern. The broadside concentration is four 12-inch and seven 6-inch guns. The secondary battery is a very powerful



LATEST JAPANESE BATTLESHIP, "SHIKISHIMA." DISPLACEMENT, 14,800 TONS; SPEED, 19·03 KNOTS.

one of twenty 12-pounder rapid-fire guns, disposed on the main deck, on the upper deck and on the superstructure, and eight 3-pounder rapid-fire guns and four 2½-pounder rapid-fire guns carried on the superstructure and in the tops. There are four 18-inch underwater discharges for Whitehead torpedoes.

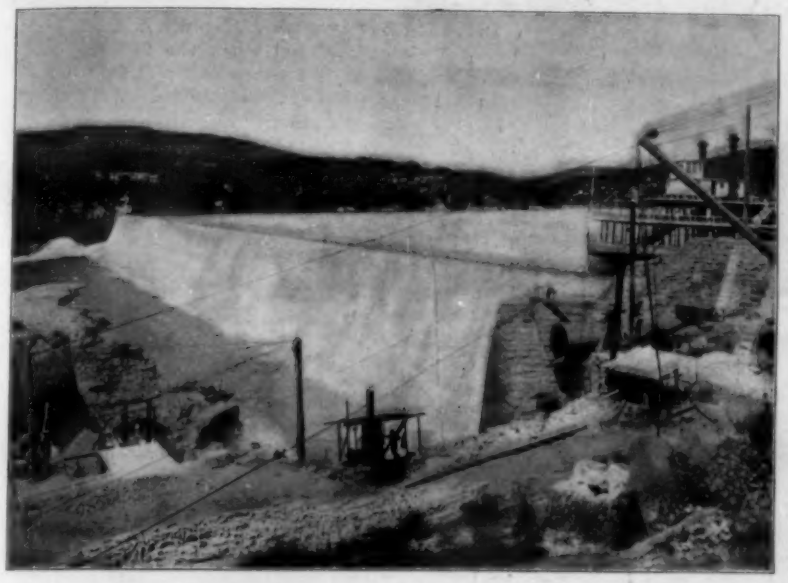
On her full speed trial this fine vessel attained a mean speed of 19·03 knots, with 14,657 indicated horse power. With her full complement on board she will carry 741 souls.

THERE seems to be an excellent chance for paper making in the South. Every Southern State has one or more varieties of trees suitable for paper making, and there is almost an exhaustible supply of wood in the South. Paper is made out of bagasse, or sugar cane, in Texas, and out of poplar and spruce in Virginia and West Virginia.

THE FAILURE OF THE MASONRY DAM AT AUSTIN, TEXAS.

The great size and importance of the dam across the Colorado River, at Austin, Texas, and the peculiar features attending its recent failure, render this wreck one of the most interesting on record. It was about ten years ago that the scheme for damming the river at a point some 2½ miles above the city of Austin was inaugurated. The project contemplated the furnishing of electric current for water-supply pumping, electric lighting, electric railways and general manufacturing purposes. Construction was commenced in 1890, and after the work had been two years under way the Board of Public Works called in consulting engineers with a view to modify certain features of design. There seems to have been considerable difference of opinion between the engineer who was responsible for the first plans and his successor. The chief subject of contention was the contour of the downstream face of the dam and its crest, which was originally designed to be flat, but was afterwards changed to the curved form shown in the sectional view herewith presented. The flat crest was objected to on the ground that the mass of falling water, during the periods of flood, would be liable to break way the rocky bed of the river below the toe of the dam, thereby endangering the whole structure. The fact that such a controversy existed is interesting in view of the probable cause of the disaster as referred to later in this article.

The dam measured 1,125 feet on the crest line, and the height from the bed of the river to the crest was 65 feet; the width of the masonry on the foundation being 66 feet. The bed of the river at the dam location consists of what is known as medium grade limestone, while the bluffs on each side of the river are of the same material. The structure was built with a heart

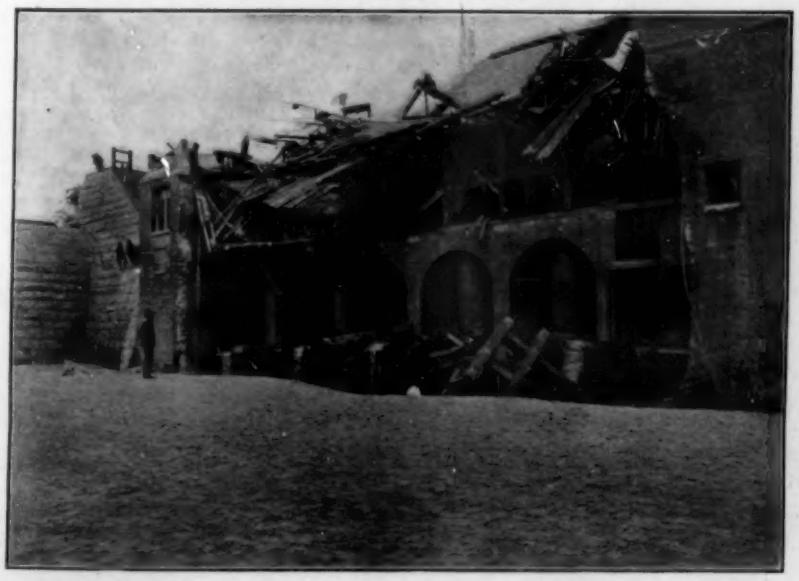


The Austin Dam During the Construction of the Power House.

View of Dam from Upstream, Taken Last November.

View from Same Position After the Wreck.

The Break Viewed from the Headgate Masonry, Showing Section of Dam Moved Bodily Downstream.



Wheelpits Exposed by the Fall of the West Wall of the Power House.

The Wrecked Power House Seen Through the Break in the Dam.

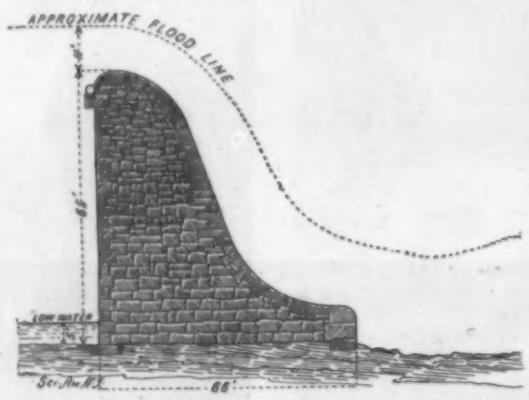
THE FAILURE OF THE MASONRY DAM AT AUSTIN, TEXAS.

of rubble limestone laid in 1 to 3 Portland cement mortar and was faced with granite. The granite blocks were laid in 3-foot courses, and care was taken to make the upstream face of the dam thoroughly impervious. The structure was completed in the early summer of 1893, at a cost of about $612,000.

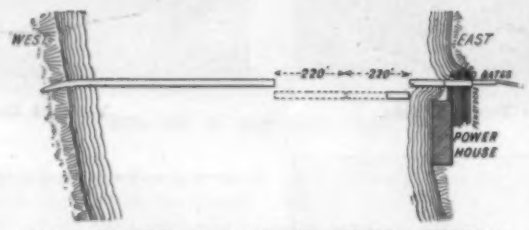
In view of the recent disaster it is significant that considerable trouble was experienced from flowing springs which were encountered both in the bed and banks of the river during construction; and, indeed, the history of the dam has been marked by a repetition of difficulties of this kind. Shortly after the completion of the work, the water forced its way through a fault in the underlying rock of the headgate masonry with the result that this portion of the structure was badly wrecked, necessitating the construction of a cofferdam and the execution of extensive and costly repairs. Again in the spring of last year, it was discovered that water was forcing its way through the underlying bedrock near the upstream face of the dam not far from the headgates, and again, a few months later, another leak developed in the same locality. These indications of the unreliable nature of the limestone upon which the dam was built must have shaken the faith of the engineers in the security and permanence of this great structure.

The headgate masonry referred to was located at the eastern end of the dam and extended 16 feet above its crest, its foundations being placed upon hard rock at a level 36 feet below the crest of the dam. There were eight gates which fed the water to eight penstocks, each 9 feet in diameter; four of these led to the power house, and the other four were reserved for future extensions of the plant. The power house, which was 54 feet in width by about 200 feet in length, extended parallel with the bank of the river and at right angles to the dam. It was equipped with four 50-kilowatt and two 75-kilowatt alternating current Fort Wayne generators, two 250-kilowatt three-phase General Electric generators, four 100-kilowatt Thompson-Houston 500-volt generators, four 90-light Wood arc machines, and two 4,000,000 gallon pumps. At the time of the disaster there was a heavy rainstorm, and the Colorado had risen until there was 11 feet of water passing over the crest of the dam. The resultant pressure proved too much for the structure, which gave way vertically at two points, one about 100 feet from the eastern end and another about midstream, the whole intervening 440 feet being pushed bodily downstream for a distance of 40 or 50 feet. This 400 feet, during its transition, maintained its line and vertical position. It then appears to have broken into two pieces, which remained intact for about one hour after the break. Then the western section gradually gave way to the undermining of the water, broke up, and was washed down the stream. The remaining section succumbed shortly afterward, only the small portion seen in our illustration being left to show how far downstream the massive wall of the dam was pushed. As the flood subsided the outward pressure of the water contained within the power house burst open the western wall, bringing down the roof and producing the complete wreck shown in our photographs.

As to the cause of the disaster, it will doubtless be found that the impact of the enormous mass of falling water upon the bed of the river below the toe of the dam had washed away the limestone rock, leaving nothing but the frictional resistance between the base of the masonry and the bed of the river to oppose the downstream thrust of the water. It is stated that the section of the dam, as originally designed, provided for four cut-off trenches in the underlying bedrock, but it now seems that only two trenches were built, as shown in the accompanying section of the dam. If any washing away of the rock below the toe of the dam actually took place, the resistance offered by the downstream cut-off trench would be destroyed, and there would be nothing but the holding power of the masonry in the upstream trench coupled with the frictional resistance, to prevent the whole structure from slidingrbodily down the bed of the river.



CROSS-SECTION THROUGH THE AUSTIN DAM.



PLAN OF DAM AND POWER HOUSE, SHOWING APPROXIMATE LOCATION OF BREAK.

VALUE OF SEA BIRDS.

BY PROF. C. F. HOLDER.

Remarkable as it may seem, it appears to be a more or less prevalent belief among certain people that sea birds possess absolutely no value as economic factors in the realm of nature. Certain individuals consider it sport to shoot gulls and similar birds as practice; others assume that gulls are a nuisance and should be killed off without mercy. An interesting illustration of this was recently developed in Southern California where a few citizens had the temerity to take a stand for the birds. The writer noticed that gulls were being employed as targets and slaughtered to afford practice to pseudo-sportsmen; and, finally, it was discovered that there was an unusual demand from taxidermists and curiosity dealers for feathers of almost every kind. Not only was there a price upon the head of every humming bird, bluebird, condor or heron, but the tame gulls and pelicans, so attractive a feature of the seashore, were also in demand and evidently doomed. Investigation showed that Chicago dealers had found that the feather supply of the Eastern market was short, and were turning their attention to the Pacific coast. One man had an order for all the pelican breasts he could obtain. Another desired gull wings galore; and as a result, a war of extermination was begun.

San Pedro and Santa Catalina Island, Cal., seemed to be the objective points of the bird killers, as here the birds were numerous, and every day boats went out with gunners, one boat bringing in on one occasion over twenty pelicans. An appeal to the public was made through a Los Angeles journal, and public interest was at once aroused and a demand made for a local law which would afford protection to the unprotected birds.

The defense took the ground that the gulls were scavengers and of prime value to the State; of greater value, in fact, to the citizens along shore than to the dealers in feathers in Chicago, and other centers where feathers are in demand. The writer prepared as elaborate a statement as possible bearing on this point, presenting facts which were intended to show that the gulls on the Atlantic coast, on the Gulf of Mexico and on the Pacific, in fact wherever observed, were of great benefit. An appeal was made for the birds as a natural ornament to the localities in which they were found. Many people, ornithologists and laymen, testified along these lines. Residents of the town of Redondo, Santa Monica, San Pedro and Avalon testified to the fact that the birds are the natural beach scavengers, and that some of these places would be unhealthy if birds were removed.

VALUE OF SEA BIRDS AS SCAVENGERS.

The accompanying illustration taken from a photograph at Santa Catalina Island, a famous fishing resort, tell the story of the value of birds as scavengers. Here hundreds of gulls are seen riding the waves on the beach after a storm, feeding on dead fish that have washed in. The majority are on the water, rising over the heavy breakers in scores as they come in, to alight again and feed upon the fishes that are rolled over and over by the waves. Others are patroling the beach, picking up the objects cast ashore; and so perfectly is this work done that in a short time no remains of the dead fish, that might become a nuisance, are found there. The birds at this time present a most attractive spectacle, and many people collect to watch their movements.

In Avalon Bay a number of professional fishermen follow their calling, and when the fish are cleaned every morning it is an interesting sight to observe these scavengers perform their duties. With them in winter are many brown pelicans, and all are so tame that they gather about the head fisherman, a Venetian, and take the rejectamenta from his hand, some of the old gulls even allowing him to take them up. It is not necessary to carry the refuse out into the channel; these birds remove it all; in fact, fight for it. This is true of the gulls all along shore, and this place is mentioned especially as the birds are perhaps tamer here than elsewhere; but everywhere they are the natural health guardians of the coast, performing their duty so well that from San Francisco to San Pedro, in the observation of the writer, there is not a spot that becomes offensive by the accumulation of fetid matter.

It would seem that the standing of the gulls in this respect was beyond dispute, but the attempts of dealers and their representatives in their efforts to prevent any bird-protecting law from passing at San Pedro, demonstrated that there are many who affect to believe that the gulls are not scavengers and should not be protected. The most remarkable testimony was introduced. Men testified that gulls were a detriment to the harbor and a menace to public health. One man stated that the killing of gulls was necessary to enable him to obtain a living, and evidence showed the extraordinary fact that he had been killing the birds to use, not the plumage, but the bodies as baits to his lobster and fish traps, and as bait for certain fish. Some of the testimony even at this time is almost past belief and well illustrates that a deep and soggy ignorance still holds in the civilized parts of the country.

The sea birds of the Pacific coast are not alone scavengers, but they constitute one of the charms of the country. An appreciation of this is termed sentiment by some. The long lines of slags flying by the outer islands, the flocks of brown pelicans which swim into the little bays, the scores of grebes and divers which lurk about the wharves, the long-winged albatross and frigate bird which occasionally reach these shores, and many more, have been the delight of many a voyager and traveler, who have made the trips to the California islands to view them. At present the sea birds, including the brown pelican, are protected, though doubtless there are poachers, and in a few years the increase of birds will be readily noticed as the killing has been going on for ten or more years on the Pacific.

If it were possible to reach the women of America through their multitudes of clubs, and arouse them to the fact that with them rests the responsibility of aiding in the extinction of birds, much could be accomplished. A few months ago a "feather manufactory" was burned on Long Island, and the newspapers gave accounts of the losses which were marvelous, showing that men were employed to do nothing else than shoot birds; the orders were in all probability, to kill everything in sight. Artificial feathers could easily be made so that the most critical person could not detect them.

Some dealers in feathers and their friends claim that birds are not decreasing, but the writer knows localities in Florida, where in 1860, birds were seen in thousands, that are now deserted. The great marsh by the sea, in Southern California, which twelve years ago was the winter home of innumerable white herons knows them no more. England alone uses thirty million birds for decorative purposes, and to provide all Europe one hundred and fifty million are annually destroyed; and when we add America it brings the sum total up to three hundred million. London also takes four hundred thousand humming birds every year from this continent, and three hundred thousand would, in all probability, not meet the demands for America. England imports six thousand birds of paradise yearly, and these birds are doomed; while four hundred thousands miscellaneous birds are used. Some bird lover had the curiosity to watch the auction rooms of a London house four months, and it was found that during that time eight hundred thousand East and West Indian bird skins were sold here. One Chicago dealer received thirty two thousand humming birds in one consignment; the same number of aquatic birds (gulls), and three hundred thousand wings. These figures are significant, but the secretary of the Audubon Society, of Massachusetts, to whom the writer is indebted, for the figures given, could doubtless give a

darker page, and an accurate statement of the birds destroyed in a single year to provide the women of the world with feathers could be made, it would astonish those who affect that the question is one of mere sentiment. Unless something is done many birds, valuable as scavengers, as insect eaters and as objects of beauty, will be wiped out of existence.

Hypo in the Developing Bath.

It has been the general rule that the presence of hypo in the developing bath should be carefully avoided as causing fog or destroying the image; however, certain developers, such as metol, orthol and others, permit the addition of a small proportion of hypo, this giving greater clearness to the negative. This proportion should not exceed a certain limit, the only developer to which hypo may be added in any considerable quantity being pyrocatechine, and with this developer a combined developing and fixing bath may be made. Dr. E. Vogel, now deceased, made a number of experiments in this direction, and was successful in preparing a bath of this kind. He found that, as pyrocatechine is a rapid and powerful developer, an excess of caustic potash is not necessary, but only the proper proportion to carry on the reaction. He recommended the following formula for a combined developing and fixing bath. It is in concentrated form and should be diluted with water for use:

Pyrocatechine, 7 grammes; caustic potash, 7 grammes; sodium sulphite, 30 grammes; water, 75 c. c.

This developer gave excellent results when used as the base of a combined bath. The proportion of hypo varies with different makes of plate, as some of these require a much longer time for fixing than others. The combined bath may be also used for positives and for bromide prints.

The Earthquake at San Jacinto Mountain.

It has been discovered that a part of the San Jacinto Mountain, San Jacinto, Cal., has slipped into a subterranean cavern. The territory covering 600 acres at an elevation of 4,000 feet, was dislodged by the Christmas earthquake and slipped 150 feet lower down than it had previously been, and the face of the new valley is thickly traversed with fissures and cracks. The earthquake has been succeeded by a dozen of light shocks and though they are becoming infrequent, the residents are still much alarmed.

Correspondence.

One More Word Concerning Superposed Turrets.

To the Editor of the SCIENTIFIC AMERICAN:

Having carefully read all the articles, concerning superposed turrets, that have come to my notice, I find, as stated in the SCIENTIFIC AMERICAN of April 14, that the opposition to the adoption of this type of turret can be said to be of two classes, structural and military. The structural question having been successfully disposed of, the military still remains, and probably will remain until the actual service for which the ships were designed, on which these turrets are placed, shall have decided the question.

It is my purpose in writing this letter to put forth a point of view which I have not seen taken as yet.

One of the disadvantages claimed for the double-deck turret system is that the 8-inch and 13-inch guns cannot be respectively trained on the lightly and heavily armored portions of a ship at the same time, should it be so desired. This, it seems to me, can be done since the 8-inch guns can be elevated independently of the 13-inch guns. Thus, while the 13-inch are trained on the heavily armored portion of a ship—which will most likely be near the water-line amidships, where the most damage could be done by a successful shot—the 8-inch could be trained upon the vertical side-armor directly over the point of attack of the 13-inch guns, which is also a harvest for shells; for it does not necessarily follow that because the four guns have to be revolved simultaneously they have to be elevated and depressed in unison.

But why train the guns on the differently armored portions of a ship when the most effective results can be obtained by training them on a common mark? What armor can resist the instantaneous impact of four large caliber projectiles? The desire to train the 8-inch guns upon the lightly armored portions of a ship arises from the fact that they are not designed to attack the heaviest armor. But, in the double-decked system, do not the 13-inch shells "pave the way" for the 8-inch shells, provided the proper charge of powder be used? Do not the 8 inch shells reach their mark before it has recovered from the shock of the heavier projectiles, and thus have easier access to the ship? It appears that four shots planted at the same place almost instantaneously would do far more damage to a ship, if not enough to sink her, than if the guns were trained independently.

In your calculations of the apparent number of shots that would have to be fired before a turret would be struck, you have overlooked the fact that the turrets of the "Kearsarge" and "Kentucky" present a great deal larger target than did those of the Spanish ships. Yet, on the other hand, the increased weight which the superposed turret and guns gives to the turret as a whole, greatly increases its power of resisting any projectile that might strike it.

Believing that these points of view might be of interest to your readers, I take pleasure in submitting them.

CARLOS DE ZAFRA.

New York, April 14, 1900.

The Current Supplement.

The current SUPPLEMENT, No. 1269, is filled with interesting matter. "The Famine in India" is the subject of the first article, which is accompanied by engravings showing the terrible condition of these people. "The Cruise of the 'Albatross'" is concluded in this issue. "The Assumed Inconstancy in the Level of Lake Nicaragua; A Question of the Permanency of the Nicaragua Canal" is by C. Willard Hayes, of the United States Geological Survey. "Modern Field Artillery" describes, in great detail, the way in which mountain guns are transported. "The Standardization of Automobile Batteries" is by James K. Pumpelly. "The Roman Forum" is a most interesting article by Richard Norton, and is accompanied by excellent engravings of new finds. "Shipping and Shipbuilding in the United States" is by James W. Ross. "Telepathy and Trance Phenomena" is by James H. Hyslop, Ph.D. "The Training of Dogs" is an illustrated article. "Review of the Traffic Questions in France" is by C. Colson. "New Cellulose Industries" is by A. D. Little.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

ROLLER-HARROW.—CHARLES WEHRENBERG, Mound City, Ill. The rollers of this harrow can be adjusted so that sufficient space can be obtained between them to accommodate a row of corn, or so that two rollers can be brought so closely together that they will act as a single long roller. Cleaners are provided for the harrow-teeth, which can be adjusted to correspond with the rollers or drums. The supporting wheels can be quickly brought into engagement with the ground and caused to act through the medium of attached levers to raise the rollers or drums from the ground. The harrow can be built with or without supporting-wheels.

Bicycle and Automobile Appliances.

BICYCLE-PUMP.—JOHN H. ROBINSON, Washington, D. C. The ordinary hand or foot pump necessitates the use of a flexible tube and lacks both power and efficiency. The inventor has devised a pump which requires no rubber connecting-tube, and which is directly attached to the tire-nipple, so that money, time, and labor are saved. Less force is required to operate the pump, and a greater efficiency is obtained.

ANTI-FRICTION-BEARING FOR WHEELS.—HARLAN P. COLBY, Grand Rapids, Mich. The purpose of the invention is to provide a bearing of simple construction by means of which friction will be reduced to a minimum. The bearing can be readily adjusted when worn. A housing carried on the axle contains a roller engaging the spindle and having tapered necks engaging tapered bearing-rollers. The outer ends of the rollers engage adjustable thrust-rings. Guide rollers engage the lower portion of the spindle.

Engineering-Improvements.

PUMP-VALVE.—FRANK B. ECCLESTON, WILLIAM F. MILLER, and JOHN A. NELSON, Nebraska City, Neb. To the valve-seat a stem is secured having a head. A plate mounted above the seat moves on the stem and has a beveled annular flange. A spring bears between the head of the stem and the plate to throw the plate toward the seat. A housing having an enlarged annularly-recessed lower end, incloses the stem and spring. The lower portion of the housing incloses and is secured to the plate. A valve-ring is held between the beveled flange of the plate and the annularly-recessed lower end of the housing. The valve-ring is thus protected from corrosion, and is easily placed in position.

ROTARY ENGINE.—CARROLL M. BELL and GEORGE E. BLAKE, Greencastle, Ind. The rotary engine has a concentric piston working with shiftable abutments, so that the piston can be driven continuously, the abutments moving in and out of the path of the piston to permit the passage of the piston past the abutments.

VALVE.—JOHN C. WOOD, Raton, New Mexico. The invention is concerned with improvements in valves and means for actuating these valves to control the entrance and exhaust of the motive agent for actuating the piston. The valve is mounted to oscillate on a parallel plane with the face of the piston. A connection between the valve and the piston extends axially into the valve, whereby the valve is moved as the piston reaches the ends of its strokes.

Mechanical Devices.

TYPE-WRITER.—MANUEL S. CARMONA, Mexico, Mexico. The machine is of the five-key type previously devised by the same inventor. In the present invention the type is carried by flexible bands which wind on spring-rollers and are moved lengthwise by the keys, the extent of the movement depending on the keys struck. The machine automatically varies the spacing, so that, for example, the feed will be greater for capitals than for small letters. The type-writer differs from that previously patented by the inventor, chiefly in details of construction.

WEIGHING AND BAGGING MACHINE.—ALONZO C. BOSWORTH, Putnam, Conn. This machine is especially adapted for weighing and bagging grain. The machine can be used in connection with any platform scale, and so adjusted as to shut off the supply of grain as soon as a certain weight of material is obtained and indicated by the scale-beam properly balanced. A grain-receiving hopper is mounted on the scale-beam and provided with means for holding the bag. The support for the bottom of the bag is capable of adjustment to hold bags of different lengths.

LATHE-ATTACHMENT.—HARRY T. SHEARER, Scotland, Penn. The purpose of this invention is to provide means whereby the carriage on an engine-lathe can be independently adjusted of the driving mechanism, thus permitting the tool to be accurately engaged with the work at all periods during the operation of the lathe. Should it become necessary in cutting a screw, for example, to remove the tool temporarily from the lathe, the tool, when replaced, can be easily adjusted to the work without the usual inconveniences.

BORING IMPLEMENT.—WILLIAM T. MAXWELL and GEORGE J. SPAHN, 943 W. Lombard Street, Baltimore, Md. The implement is used for boring through joists or in corners, or at angles where the ordinary brace or bit cannot be used. The implement comprises a threaded shaft with a back bearing, having a flaring front end, and a tapered nut made in halves. A disk is provided, having slots and screws passing therethrough and entering the respective halves of the nut. The disk serves to hold the parts of the nut connected, so that one half is exactly opposite the other. The tool is particularly useful in boring through joists in electric light work.

Miscellaneous Inventions.

VEHICLE RUB-IRON.—ELISHA W. PALMER, Fullerton, Cal. The rub-iron is composed of a roller which can be made very short and from which the wheel cannot slip rearwardly. The iron effectually prevents the front wheels from wearing away the body or the running gear of the wagon, or from unduly wearing itself away when the wheels are cramped. The device likewise serves to prevent the front wheels' catching under the body of the vehicle.

HOT-AIR REGISTER.—EDWARD J. MALLEN, Manhattan, New York city. The slats of sheet-metal are arranged to overlap, so as to produce a smoke-tight connection. The frame is also made of metal, the braces for the frame constituting means for the attachment of a cover. The trunnions of the slats are integral with the body of the slats; and the bearings of the shifting devices for the slats are also integral with the slats. The several parts of the sheet-metal body are so braced that it will have practically the rigidity of a cast-metal body.

FILE.—CHARLES V. HENKEL and EDWARD M. ANDERSON, Manhattan, New York city. This file is in the form of a temporary binder for holding letters and the like. It embodies clamping-sections provided with prongs for piercing the letters and actuated by springs, so that when the restraining-catch is released, the clamping-sections will ordinarily open, the restraining-clamp serving to hold the clamping-sections against the springs in locked position. The clamping-sections are mounted to move in precisely the same time, so as to throw the prongs in and out in like manner.

COAL-SCREEN.—CHARLES GESKE and CHRISTIAN MILLER, Seattle, Wash. The bars of this screen can be easily adjusted to regulate the size of the mesh. The bars are so constructed that, when in position, they will cause the coal or other material to be effectually screened.

SPEED-CONTROLLER AND TIME-INDICATOR FOR SELF-PLAYING PIANOS OR ORGANS.—CHARLES H. FREYER, Marietta, Ga. The invention provides an improved speed-controller and time-indicator for selfplaying pianos and organs, which is arranged to enable the performer to control the speed of the instrument accurately according to the correct time stated on the notation of the music to be played.

PROTRACTOR.—JOHN E. EVANS, Wilkes-Barre, Penn. This protractor is to be used for plotting charts, maps, and the like. By its means any number of degrees and minutes at either side of a meridian or other starting line can be marked off without mental calculation. The protractor is of sufficient weight to retain its position on the work, and therefore does not require clamps or extra weights, such as are usually found necessary.

PROCESS OF MAKING STRONTIA.—SPENCER B. NEWBERRY, Sandusky, Ohio. Strontium sulfate unmixed with other materials can be decomposed by heat; but the process is slow and uncertain, owing to the fusibility of the sulfate at high temperatures. The inventor has found that the decomposition is greatly facilitated and the fusion prevented by adding to the sulfate a quantity of difficultly-fusible basic material, such as magnesia, lime, carbonate of magnesia, or carbonate of lime.

CUSHION DEVICE FOR DOORS.—WILLIAM F. DAVIS, Lake Charles, La. The invention provides a pneumatic cushion for the doors of ice-boxes or other structures, which cushion is automatically inflated through the act of opening the door, the air-supply being cut off from the cushion while the door is closed. Should the cushion be overcharged, the surplus air automatically escapes. If it be so desired, the cushion can be inflated by means of a pump.

ADJUSTABLE CUTTING-STICK.—JOSEPH M. COHEN, Manhattan, New York city. Cutting-sticks are used in cutting stock for the manufacture of neckties or similar goods in which the edges are parallel. The stock is cut in different widths; and at present it is necessary to have a cutting-stick for each width. To overcome this objection, the inventor has devised a stick which can be quickly and readily adjusted to any desired width, thus making one stick answer for all purposes for which several sticks are now employed.

NUT-LOCK.—ZACHARIAH W. WELCH and EUGENE H. BLACKSHEAR, McComb, Miss. The bolt has an end recess; and the nut is formed with a number of diametrically-opposite grooves extending from its central opening over one face and in its sides. A spring-yoke has a cross-bar and side-bars fitting accurately in the recess, registering face grooves, and side grooves. There are no projecting parts; for the spring-yoke, when in place, is exactly flush with the outer face and sides of the nut. The number of grooves provided renders the nut easy of adjustment.

ARTIFICIAL DENTURE.—DR. ARTHUR T. GLEW, Germantown, Ohio. When only the lower, anterior, natural teeth, are standing, and the gums preclude the insertion of a partial lower denture, all the mastication is done on the anterior teeth: and it is only in exceptional cases that the suction of the upper plate is sufficient to overcome the leverage of the lower on the upper incisors. Dr. Glew has not only overcome this difficulty, but even added to the security of the upper plate by providing such teeth with a rear projection or ledge against which the lower incisors bite, and thus apply a leverage tending to force the upper plate rearward and upward, so that the suction is increased rather than diminished, and the plate held more firmly in place. The attachment of the upper incisors to the plate proper is, moreover, not weakened, as in the ordinary construction.

Designs.

FRUIT-PICKER.—MARQUIS D. L. HARTLEY, Dehesa, Cal. The fruit-picker comprises a shield or guard which is slipped over the thumb, and which is provided on its under surface with a cutting blade whereby the fruit-stem is severed.

TWINE-HOLDER.—JOHN A. THOMSON, Seattle, Wash. The twine is contained in a casing in the form of a truncated cone. The twine is first passed upwardly through an eye in a cross-bar, then through the guides formed by various corrugations below the cross-bar, and finally through a corner-eye in the cross-bar.

UPPER INCISOR TEETH.—DR. ARTHUR T. GLEW, Germantown, Ohio. This design relates to a new form of upper incisor teeth, essentially such as form part of the improved denture for which Dr. Glew has obtained a mechanical patent of same date, referred to in a foregoing notice. The teeth have a straight transverse groove of uniform depth extending across their lower edges, practically parallel to their front and rear sides. The projection forming the rear side of the groove is shorter than the front one, so that it is not visible from the front.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7864) C. T. D. asks: 1. Would vulcanite do for the plates of a Wimshurst electrical machine? A. Vulcanite can be used for the plates of Wimshurst machine. 2. Can you tell me where to procure tinfoil? A. Tinfoil can be bought from any dealer in electrical goods, or chemical supplies.

(7865) D. E. writes: I am a boy, twelve years of age, and I find much pleasure in reading Notes and Queries. I am interested in the study of electricity, and would like to find out more about it. 1. If a circular sheet of steel were magnetized, where would the poles and the neutral part be? A. It can be magnetized with one pole in the center and the other around the circumference, or with one-half plus and the other minus, on the two sides of a diameter. 2. Why is not the battery of the telephone used to ring the call bell? A. The battery would then be in used all the time and would soon be worn out. The magneto does not work except when the armature is turned and there is no wear in use except the wear of the axle by turning. 3. Can the telephone receiver be used equally as well as a transmitter, and vice versa? A. Yes, but it is not a very good one. 4. Are arc lights arranged in series, or in multiple arc? A. On arc lighting circuits the lamps are put in series. Arc lamps on incandescent circuits are put in multiple arc. 5. Can a soft iron rod be used in a telephone receiver in place of a magnetized steel one? A. No, a permanent magnet must be used. 6. Is the diaphragm in a telephone receiver iron or steel? A. Soft iron, such as tintypes are made upon is often used. 7. Is the volt a measure of pressure of electricity, and the ampere a measure of flow? A. The ampere is the unit of current strength. The coulomb represents the amount of electricity conveyed by one ampere of current acting for one second. We should advise you to buy "Experimental Science," price $4, by mail, in which you will find the answers to many such questions as these. A good text book of Physics will also be a good thing for you. We can recommend Avery's "School Physics."

(7866) A. P. B. asks: Which is more powerful a natural lodestone or an artificial magnet? Where can it be obtained? Does it soon lose the power of attraction? A. Lodestone has only a slight power of attraction. Even the strongest pieces will only lift small pieces of iron or steel. It is usually hung up and small tacks are held up by it, as many as it will hold. It comes to rest in the magnetic meridian and so remains. It will not lose its power of attraction. We do not know of any special book on the lodestone.

(7867) C. M. D. asks: Would you kindly answer a few questions for me? 1. How is the battery resistance found? A. Your questions suggest a college examination paper. We will either answer them, or better for you, put you in the way of finding the answers for yourself. There are several modes of measuring the internal resistance of a battery. The simplest is to put two cells in opposition, so that they will send no current, and then measure their resistance as any other resistance is measured. For the full treatment of the subject, see Carhart's "Primary Batteries," price $1.50, by mail. 2. How is the horse power of a stationary engine calculated? A. The horse power of a steam engine is determined either by the indicator diagram, or directly measured by a dynamometer or friction brake applied to the flywheel. The actual horse power is less than the indicated by the friction of the machine. See Goodeve, "Text Book of the Steam Engine," price $2.50, by mail, or Kent's "Pocket Book," price $5. 3. What is the specific resistance of a solution of copper sulphate with 8 volumes of water at 9 degrees C.? A. This question is not stated so as to admit of an answer, taking the temperature into account. It is not possible to determine the volume of a discontinuous substance like copper sulphate, as compared with a continuous one like water. The only proper mode of making solutions is a percentage one, by weight. The tables give the resistance of a copper sulphate solution, 1 centimeter cube, as follows: 5 per cent, 56 ohms.; 10 per cent, 28 ohms; 15 per cent, 25; 20 per cent, 20 ohms. These numbers are true at 18°C. and increase with a rise of temperature about 2 per cent per degree C. The probable error is about 10 per cent. The specific resistance can be calculated for any assumed standard, for example, silver, by referring to a table of absolute specific resistances, or resistances in the C. G. S. system. Such tables may be found in Whiting's "Physical Measurements," price $5, by mail. 4. Can a bar of soft iron be magnetized to any degree? If not, how can it be told when the iron is saturated? A. A bar of soft iron can be magnetized by winding a coil of wire around it and sending a current of electricity through the coil, as is done in every electro-magnet, till it is saturated. The practical limit for saturation is, for gray cast iron, 70,000 lines per square inch, and for soft wrought iron, 100,000 lines per square inch. 5. How are the magnetic lines of force calculated per square inch? A. The lines of force are based on the production of one line of force per square centimeter by one dyne of force on a unit pole. The calculation of the resultant force and lines of force can be found in text-books of electricity. Thompson's "Elementary Electricity and Magnetism," price $1.40; Thompson's "Electromagnets," price $6; Fleming's "Magnets and Electromagnets," price $3, and Hawkins and Wallis' "Dynamo," price $3, all by mail. All these are standard works. One to whom such questions come should have such books. 6. Please give a simple meaning of ampere turns. A. An ampere turn is produced by one ampere flowing once around a circle. This is very simple. To find the ampere turns measure the amperes of current, count the turns of wire, and multiply the two together.

(7868) A. F. O. asks: If the earth should cease to rotate the Mississippi would flow rather swiftly toward the north. Is that true? A. Certainly, it is true. The earth is not a sphere with all parts of its surface equally distant from its center; but the diameter through the equator is about 26 miles greater than that through the poles. If one should travel from the pole to the equator, he would climb a hill 13 miles high, though he would not be conscious of it. A river flowing south is at its mouth further from the center of the earth than it is at its own source. Or, put in common language, it runs up hill. The cause of this is found in the so-called "centrifugal force" of a rotating body, which causes each part to place itself as far from the center of rotation as possible, which also gives an outward (tangential) force to each part. In the case of the earth at its present velocity of rotation this force lightens all bodies at the equator by 1 289 of their weight. This force it is which deforms the water level line from north to south, so that the southern end of a water level line is higher than its northern end.

(7869) W. & Co. ask: What is the amount of air practically necessary for the complete combustion of the following fuels per pound anthracite coal, refined kerosene, and gasoline; and what is the nature of the products of the combustion and their cubic contents at atmospheric pressure and temperature; and what, if there is any, hydraulic packing will stand a working pressure of 200,000 pounds per square inch? A. Anthracite coal requires for complete combustion from 11 to 12 pounds of air per pound of coal, or from 132 to 144 cubic feet of air at 60° Fah., varying with the quality of the coal. Kerosene requires nearly 18 pounds of air per pound of oil, or 235 cubic feet. Gasoline requires 11 pounds of air, or 143 cubic feet per pound of liquid. The products of combustion if perfect, should be carbonic acid with a variable percentage of carbonic monoxide mixed with the nitrogen of the air. At atmospheric pressure and temperature the volume will be increased by from 10 to 12 per cent for coal, but somewhat less with kerosene and gasoline. We know of no packing that will resist the hydraulic pressure stated.

(7870) W. W. asks: 1. Explain the principles of Marconi's wireless telegraphy. A. We have printed many articles on wireless telegraphy. See SUPPLEMENT, Nos. 790, 925, 1124, 1177, 1192, 1213, 1218, 12 9 and 1246, price ten cents each. 2. Why is it not operative over 86 miles? A. Messages have been sent over more than 100 miles and no limit can be set to the distance. The height of the vertical wire alone limits the distance. When this is raised about 150 feet messages can be sent 100 miles.

NEW BOOKS, ETC.

JIM SKEEVERS' OBJECT LESSONS. On Railroading for Railroaders. By John A. Hill. New York: The American Machinist Press. 1899. Pp. 157. Price $1.

The page is 2¼ inches wide and 8 inches high, a decided novelty. As a general thing, knowledge conveyed by way of story or dialogue is either badly conveyed or is not worth the telling. The present tall and narrow volume is an exception, and the little "preachments" are admirable. The author knows his subject and can write upon it withal. It is a safe book.

HOW TO USE PORTLAND CEMENT. By L. Golinelli. Translated by Spencer B. Newberry, E.M., Ph.D. Chicago: Cement and Engineering News. 1899. 16.mo. Pp. 29. Price 50 cents.

DIE FLÜSSIGKEITS-SCHRAUBE. Winddruck, Luftschiffs- und Schiffschraube, Kanalschiffs Luftschraube, Niederdruck-Windrad, Graf Zeppelins Luftschiff. Von Paul Pacher. Vienna: A. Amonesta. 1900. Octavo. Pp. 66. Paper. Price 50 cents.

SCHILLING'S SPANISH GRAMMAR. Translated and Edited by Frederick Zagel. New York and London: Cassell & Company. 1899. 12mo. Pp. iv, 340.

Considered purely as a grammar, it cannot be denied that this book had been prepared with scholarly understanding and painstaking care. Considered as a means of acquiring a knowledge of Spanish (and this, we take it, is the main purpose of the work) the "Grammar" is not essentially different from a horde of similar publications. It is doubtful whether a language should be taught on the principle of compelling a pupil to memorize disconnected words, which are to be applied in translating meaningless sentences constituting "Exercises. "In the more modern methods of language instruction, the pupil learns whole sentences, in which the words are idiomatically grouped to convey complete thoughts. The pupil, therefore, thinks of a word as a member of a complete sentence, and not as an isolated symbol. The work of Mr. Zagel has been conscientiously performed. The book in its English dress bears all the marks of an original work, which is, perhaps, the greatest compliment that can be paid to a translator.

DIE ENTWICKELUNG DER ASYMPTOTISCHEN TELEGRAPHIE (ELECTRISCHEN "TELEGRAPHIE OHNE DRAHT"). Von Dr. Rudolph Blochmann. Mit 17 Skizzen. Berlin: Ernst Siegfried Mittler und Sohn. 1898.

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Car draft plate, Collier & Naery	32,545
Car end sill, J. M. Hansen	32,543
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Car platform, Collier & Naery	32,546
Casket plate, A. R. Betts	32,551
Chimney cap section, J. Cooper	32,536
Coat pad, G. Goldman	32,553 to 32,556
Coin mat, H. C. Underwood	32,525
Electric light globe, H. Stenz	32,529
Fire extinguishing nozzles, member for fusible couplings for, J. Kane	32,534
Gas generator casing, acetylene, A. Boeckeler et al	32,552
Grate, J. L. Campbell	$1,530
Hame attachment, G. M. Light	32,540
Horseshoe, W. Velden	32,541
Lamp bracket, W. P. Crary	32,528
Ozone generator, H. E. Waite	32,526
Paper, J. J. Geisinger	32,560
Piano back, J. Dierdorff	32,548
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Pot scraper, G. A. Robbins	32,537
Prism plate, R. M. Cox	32,550
Ram body portion, hydraulic, J. M. Stratton	32,535
Rug, W. H. Bell	32,559
Sash fastener lever, H. B. Sargent	32,532
Shade roller bracket, E. F. Hartshorn	32,530
Telephone standard, W. D. Gharky	32,527
Tire core, vehicle, H. C. Tyler	32,542
Trousers hanger, A. L. Ross	32,533
Vessel hull, W. B. Motheral	32,547

TRADE MARKS.

Ale, lager beer, and porter, True W. Jones Brewing Company	34,489
Borax, Patent Borax Company	34,501
Borax for certain named uses, preparations of, Patent Borax Company	34,502
Brick, fire, E. W. Glaenser	34,512
Brushes, Rennous, Kleinle & Company	34,511
Butter, J. G. Turnbull	34,493
Cigars, Pendas & Alvares	34,486
Dairy products, certain named, Anglo-Swiss Condensed Milk Company	34,494
Dolls, Hamburger & Company	34,479
Dress goods, Delgado Mills	34,481
Fabrics or body garments, certain named, P. Beiersdorf & Company	34,482
Fish in hermetically sealed tins, National Packing Company	34,490
Flour, wheat, Geo. P. Plant Milling Company	34,498
Grinding mills, Smalley Manufacturing Company	34,515
Hardware, general, Seattle Hardware Company	34,513
Insecticides, Anti-Sect Chemical Company	34,505
Mattresses, pillows, cushions, and hassocks, Ostermoor & Company	34,485
Medicines, certain named, C. Franklin	34,509
Medicines in capsule form for certain named diseases, Grape Capsule Company	34,510
Oatmeal, Illinois Cereal Company	34,496
Oats, Seward Cereal Mills	34,495
Orangeade, F. L. Daggett & Company	34,490
Pipe wrenches, J. H. Williams & Company	34,514
Rams, hydraulic, Deming Company	34,516
Remedies for certain named diseases, Ralph & Shafer	34,507
Remedy for certain named diseases, A. B. Girardo	34,506
Rubber masks, certain named, Miller Rubber Manufacturing Company	34,480
Shoe polish and dressing, S. & R. Manufacturing Company	34,503
Soap for toilet and household purposes, Patent Borax Company	34,500
Tea, Peek, Frean & Company	34,492
Teas, J. M. Bour Company	34,491
Tobacco, snuff, cigars, and cigarettes, and coffee and tea, D. D. J. Van Nelle	34,487
Tonic, blood, E. F. Fahey	34,508
Tracing cloth, Winterbottom Book Cloth Company	34,484
Underwear, nightwear, and hosiery, D. F. Halsted	34,481
Wheat breakfast food, Pillsbury-Washburn Flour Mills Company	34,497
Whiskey, rye, J. C. Horting	34,488
Wood strengthener and preservative, E. Childs	34,504

LABELS.

"Blue Knot," for canned goods, H. G. Tombler Grocery Company	7,486
"Colonial," for coffee, McCart-Christy Company	7,685
"Dog Pills," for a medicine for animals, P. L. M. Gandette	7,479
"Elixir Ferro-Mangan-Peptonate," for drugs, C. Bernstein	7,476
"Grape Sherbet," for sherbet, P. Schmidt	7,480
"Husketine," for a lotion," S. J. Kloster	7,477
"Old Home," for bread, D. B. Austin	7,485
"Pagoda," for tea, Bohea Importing Company	7,482
"Red Cross Tansy Pills," for medicine, Norman Liebty Manufacturing Company	7,478
"Sunset," for cycles, Sunset Cycle Company	7,475
"Sycamore Pure Rye Whiskey," for whisky, Saizman & Siegelmann	7,481
"Turner's Mocha Java Coffee Essence," for coffee preparations or extracts, H. W. Turner	7,484

PRINTS.

"Ask to Hear Gram-o-phone," for gramophones, National Gram-o-phone Corporation	221
"Mitis," for a medicinal extract, A. L. Carpenter	220

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